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Electrical Review.

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THE ELECTRIC LIGHTING ACT.

(*Continued from page* 42.)

IN our last notice we discussed some of the provisions made in the orders compiled for the electric light companies by Mr. J. Fletcher Moulton, F.R.S., authorising them to erect and maintain electric lines and works in the various places where application has been made, and we took the "Provisional Order" of the Metropolitan (Brush) Electric Light and Power Company for the supply of electricity within the City of London and three included parishes as an example of the rest.

Our article concluded with a review of the general description of the proposed works and of the nature and mode of supply, and we now come to the

CONDITIONS OF SUPPLY.

The undertakers shall, within a period of *two years* from the confirmation of this Order, and subject to the provisions thereof, lay down, and thereafter maintain, distributing mains along the streets and parts of streets specified in that behalf in *Schedule A* hereto. Such distributing mains shall be in all respects suitable and sufficient, that is to say, they shall be of such nature and dimensions as shall enable the undertakers to give thereby a supply of electricity in conformity with the provisions of this Order, either by the direct or storage system (and either with or without earth returns), or by any combination of such systems, at the option of the undertakers, to such customers as shall from time to time require such supply, and shall be entitled thereto under the provisions of this Order.

The undertakers shall also (so far as required by the local authorities having charge of such streets and parts of streets, and within a reasonable time of their receiving notice of such requirement) lay down, maintain, and work electric lines for public lighting along the streets and parts of streets specified in that behalf in Schedule A. The supply of electricity for such electric lighting shall be on the series or such other system as the undertakers shall select, and shall be maintained during such hours as the said local authorities shall require, and the price and details of such supply shall be settled by agreement, or, in case of difference, by arbitration.

In addition to the distributing mains specified above, the undertakers may, subject to the provisions of this Order, lay down and maintain electric lines in the streets and parts of streets specified in *Schedule B*, and in any other streets and parts of streets within the area of supply.

If at any time after the expiration of a period of *two years* from the confirmation of this Order, the undertakers shall not have laid down or shall not be maintaining suitable and sufficient distributing mains (within the meaning of this Order) throughout the whole of the streets and parts of streets mentioned in Schedule B, the Board of Trade may call upon them to lay down and maintain such mains in any or all of the said streets or parts of streets mentioned in such Schedule, and the undertakers shall with all reasonable speed lay down and maintain the same. Provided always that the undertakers shall not be compellable to lay down mains in any such street or part of a street, in case they cannot lay down, maintain, and work to a reasonable *profit such mains as aforesaid throughout the whole of the streets and parts of streets mentioned in the section of Schedule B* in which such street or part of a street appears.

We may mention that the corporations and local authorities which have applied for Provisional Orders under the Electric Lighting Act have not adopted the conditions herein set forth, in fact we believe that they have not really pledged themselves to anything.

The Schedule A referred to is as follows :—

The undertakers shall provide a suitable station and shall lay down and maintain distributing mains therefrom, to a distance of 250 yards along the neighbouring streets and parts of streets in each of three separate directions. The following is a list of such streets and parts of streets :—*

The undertakers shall also, so far as required so to do by the local authorities having charge of such streets or parts of streets, lay down and maintain mains for public lighting by arc lamps in such portions of the following streets or parts of streets as are included within the area of supply :—

Blackfriars Bridge, New Bridge Street, Farringdon Street, Fleet Street, Thames Embankment, Holborn, Chancery Lane, Upper Thames Street, Queen Victoria Street, Southwark Bridge, Queen Street Place, Queen Street, Cannon Street, Cheapside, St. Paul's Churchyard, Holborn Viaduct, Newgate Street, Old Bailey, Giltspur Street, Snow Hill, St. Martin's-le-Grand, Aldersgate Street, Poultry, Princes Street, Moorgate Street, Finsbury Pavement, Finsbury Square, City Road, Goswell Road, Pentonville Road, King's Cross Road, Farringdon Road, St. John Street, St. John Street Road, Clerkenwell Road, London Bridge, King William Street, Gracechurch Street, Lower Thames Street, Eastcheap, Great Tower Street, Lombard Street, Fenchurch Street, Aldgate, The Minories, High Street, Whitechapel, Leadenhall Street, Cornhill, Threadneedle Street, Bishopsgate Street Within, Bishopsgate Street Without, Norton Folgate, Gresham Street, Old Broad Street, and New Broad Street.

The undertakers have to accomplish the work of laying down, within two years, and afterwards maintaining, the necessary distributing mains along the streets named. It was doubtless thought that any shorter period of time—considering that we have really no experience of public electric lighting on anything approaching a large scale—would not enable the undertakers to do their work thoroughly; and we think our readers will all agree, that in the face of the many difficulties which must be encountered, the time allotted is by no means over-estimated.

More especially is this seen when the paragraph following that which contains the reference to Schedule A is perused. The work to which we have alluded is that which *must* be completed by the undertakers; but they may also, if considered desirable by them, enter still further into the field of electric lighting, and at the same time go on with the necessary operations for supplying electricity to the parishes in connection with the City, the area of which is divided up into nineteen sections, all being included in Schedule B. These sections may be operated upon one at a time as the undertakers think fit, but they are not compelled to do so. Some of the sections might be thought too poor, commercially speaking, to make the venture of lighting the respective districts worth the outlay. If, however, they are called upon to do a section and the work is not completed within reasonable limits, or if no good cause can be shown for the delay, the Board of Trade has the power to cut this area out of the undertakers' control, and any other competing company could then step in and take possession of it under certain conditions, such as taking over the conductors already laid down at a fair valuation. All this, however, appears clearly enough shown in the following clauses.

In case the Board of Trade shall call upon the undertakers to lay down and maintain distributing mains under the powers given to them in the preceding section, the following provisions shall apply :

(*a*) The Board of Trade shall give to the undertakers three months' notice of their requirements, stating the streets or parts of streets along which the undertakers are required to lay down and maintain such mains, and the section of Schedule B to which each such street or part of a street respectively appears.

(*b*) In case the undertakers shall be of opinion that they cannot lay down, maintain, and work to a reasonable profit such mains as aforesaid throughout any section named in such notice, and shall desire to have the benefit in respect thereof of the proviso contained in the preceding section, they shall within one month after the receipt from the Board of Trade of such notice as aforesaid, give notice thereof to the Board of Trade, and in case they can show to the satisfaction of the Board of Trade (or in case of difference of an arbitrator appointed in that behalf)

* A list of such streets and parts of streets shall be deposited at the office of the Board of Trade, together with the description of the lands, if any, which the undertakers propose to purchase for the purposes of this Order, and this order shall not be delivered until such list shall have been approved of by the Board of Trade and inserted in this Schedule.

that they cannot so lay down, maintain and work to a reasonable profit such mains in any such section, they shall not be compellable so to do.

(*c*) The undertakers shall be allowed *a period of one year* for the completion of the works in each section in which they are so required to lay down and maintain mains, or such period as is mentioned in that behalf in Schedule B. In case they shall be required so to lay down and maintain mains in more than one of such sections, the first of such periods shall commence at the date of the receipt of the said notice or award, as the case may be, and the subsequent periods shall follow thereon, no two periods being deemed to be running contemporaneously.

The Board of Trade may at any time, either at the request of the undertakers or otherwise, strike out from any section of Schedule B any streets or parts of streets that they may consider it advisable not to include or retain therein.

We now arrive at that part of the "Provisional Order" defining what a supply of electricity is and the duties of the undertakers in connection therewith. Gas, as we all know, may be utilised at any time during the day or night, but we have not yet attained this degree of certainty with the electric light, and therefore it is not intended that the undertakers shall be *compelled* to supply electricity *continuously*, at all events for the present. The time is probably not far distant, however, when this desirable result will be accomplished, for if electric lighting is to become general it must at least be as available as gas, that is, at *any moment*. Respecting the pressure or difference of potential in the mains, it will be seen that the maximum and minimum is fixed at 400 and 30 volts respectively.

Although we believe that incandescence electric lighting only is here referred to, a considerable range is necessary even in this, as different systems make use of different electromotive forces; therefore the defined pressure fixed by the undertakers determines the system. For instance, 110 volts would represent the Edison system as exemplified on the Holborn Viaduct, 45 volts the Swan 18-candle-power lamp, and so forth. We think, however, that a pressure of between 100 and 120 volts should be made general, and the lamps arranged to suit. The percentage allowed for variation in the difference of potential at different points in the mains appears to be ample, but the question of conductors will have to be far more carefully considered than has hitherto been the case. The same remarks may also apply to service lines entering the consumer's premises. The matter of alternating currents requires more careful consideration than we can devote to it at the present moment, especially in relation to the dangerous nature of such a supply of electricity, but the minimum of reversals appears to us to be far too low, as the effect would be apparent to the vision in the blinking nature of the light. We may say, in effect, that we do not consider alternating currents to be at all adapted for the public supply of electricity, even when the lighting question only is at issue. The stipulations on which we have thus briefly commented are as follows:—

In case the undertakers shall supply any portion of their area on the *direct system* (with or without earth returns), the following provisions shall apply:—

(*a*) The undertakers shall continuously, *during all the hours of the day or night* (save as hereinafter expressly provided) generate and maintain in their distributing mains a current of electricity of the nature and strength hereinafter defined, and otherwise in accordance with the provisions of this Order.

(*b*) During the whole of the period in which a supply of electricity is being given by the undertakers, the *potential at corresponding points of the positive and negative distributing mains* (or of the distributing main and the earth, as the case may be) shall, subject to the allowance hereinafter mentioned, differ at *each point by a constant difference*, not being less than *thirty volts*, and not being more than *four hundred volts*. Such constant difference of potential, herein termed the "*standard pressure*," shall be fixed by the undertakers and *sanctioned by the Board of Trade* before they commence to supply for private purposes, and shall not be altered except by *the permission of the Board of Trade*, and after public notice has been given during a period *of one month* of the intention of the undertakers to apply for leave to alter the same. The standard pressure may *be different for different points of the said mains*, and for different hours during the period of supply.

(*c*) The undertakers shall be deemed to have complied with the requirements of the last preceding sub-section in that behalf in case the difference of potential shall not at any point vary more than 10 *per cent.* from the corresponding *standard pressure*.

(*d*) The *resistance* of the *service lines* by which the supply is given to any consumer shall not, except by agreement, be greater than would cause the difference of potential at the positive and negative poles on the consumer's premises to be less than the corresponding difference of potential at the point of junction of the mains and the service lines by which he is supplied, by more than 5 *per cent.* of the corresponding *standard pressure* when the maximum current referred to in section 28 is passing through such service lines.

(*e*) In case the undertakers shall supply electricity by means of *alternating currents* in one or all of their electric circuits, the difference of potential (measured by its maximum value during a *complete* alternation) at corresponding points of the positive and negative distributing mains of each such circuit (or of the main and the earth, as the case may be) shall, during the whole of the period that a supply is being given by the undertakers, subject to the allowances hereinafter mentioned, have a constant value, not being less than *forty-five*, and not being more than *six hundred* volts. Such constant difference of potential (herein termed the "standard pressure") shall be fixed as provided in sub-section (*b*) of this section, and a like allowance for variation shall be permitted. The number of alternations *per minute* shall not, during such period, be less than *three hundred*.

(*f*) The undertakers shall be permitted to cease the supply of electricity in each of their electric circuits during certain intervals in the daytime, for the purposes of examining or testing such circuit or any other portions of their electric lines and works, or for repairs or other needful purposes connected with the undertaking. Such intervals shall not on the whole exceed *two hours per diem* for any one circuit, and shall so far as possible occur at stated hours for each circuit, which shall be fixed in like manner, and shall be subject to like regulations as to change as are hereinbefore set forth with respect to the "standard pressure." In addition to such intervals the undertakers shall not be required to supply during the period between *thirty minutes* after sunrise and *thirty minutes* before sunset *on Sunday*, except when from the state of the weather it may be reasonable to provide artificial lighting.

In case the undertakers shall supply electricity by means of the *storage system* (with or without earth returns) in any portion of their area of supply, the following provisions shall apply:

(*a*) The mains *from* the central storage batteries by which the electricity is supplied to the consumer's premises shall be subject to the same regulations as to hours of supply pressure, and otherwise as the mains in the case of supply on the direct system, and the portions of such mains that are used for the purpose of giving origin to service lines shall be deemed to be distributing mains within the meaning of this order.

(*b*) The undertakers may lay down, maintain, and work mains (herein termed "*charging mains*") for the purpose of charging such storage batteries. Such mains shall not be considered to be *distributing mains* within the meaning of the provisions of this Order, *and no person shall have any title to a supply by reason of the proximity of his premises to such mains.*

(*c*) The undertakers may, during any hours, charge such storage batteries by means of currents through such charging mains. Provided always, that in case they shall use such mains for the purpose of charging any storage batteries during the hours when a supply is being given to consumers therefrom, the potential in the charging mains (or main as the case may be) shall not (except by agreement) be such as to cause *any pole on a consumer's premises, to have a potential differing from that of the earth by more than four hundred volts*, and the undertakers shall disconnect and keep disconnected from such storage batteries all distributing mains and service lines, during such times as the potential in such charging mains (or main as the case may be) does not comply with the above condition.

In case the undertakers shall supply electricity by means of any combination of the direct or storage systems (with or without earth returns) in any portion of their area of supply, the distributing and charging mains of such system shall be subject in all respects to the same regulations as similar mains are respectively subject to in the direct or storage system (with or without earth returns) when used separately, and not in combination as aforesaid.

The definitions of the supply of electricity given in these "Provisional Orders" is so clear that but little opportunity is given for comment. We shall next have to deal with the Compulsory Supply, Prices to be Charged, Methods of Measuring the Supply of Electricity, Testing of Main and Service Lines, &c., and then probably we shall find more openings for remarks. In our correspondence columns will be found a letter dealing with a portion of the "Order" at which we have not yet arrived, but which is worthy of our readers' attention. *Apropos* of the subject of electric light mains, we would earnestly invite the notice of all interested in such matters to the remarkable paper on "Electric Light Leads," by Mr. Robert Sabine, which we published in our columns for January 6th, for its importance on the question of economical electric lighting cannot be over-estimated.

(*To be continued.*)

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and of Electricians.

Inaugural Address by WILLOUGHBY SMITH, President.

(*Continued from page* 68.)

THE President then traced the gradual development of the machines for producing electricity by motive-power, commencing from Faraday's discovery. He next traced the development of the electric light. With reference to the conductivity of conductors, he pointed out that "this diminishes in well-known ratios with an increase of temperature, consequently it is essential that conductors, especially those used for electric lighting, should be of sufficient capacity so as not to be affected by the current. If the current passing along a conductor increases the temperature of the same it is plain that the resistance of such a conductor is too great, and therefore its temperature and resistance will continue to increase until very prejudicial effects are reached. Perhaps the results of actual experiment will make this more clear. The experiments were made with a dynamo, the resistance of the armature of which was 0·6 of an ohm, and an arc lamp, the resistance of which was 0·38 of an ohm. In each case the circuit was metallic, and the total length of the conductor, fifty yards, insulated to a thickness of ·065 of an inch. At one part of the circuit the conductor leading to the lamp and that leading from it were placed so as to touch each other, the consequence of which was as follows: When the resistance of the conductor was ·28 of an ohm and the strength of the current 27 ampères, the dielectric became soft and allowed the conductor to form contact in twenty-five minutes. With a conductor of ·21 ohm resistance and a current of 30 ampères, the same results followed after forty minutes; but with a conductor of ·07 ohm resistance and a current of 33 ampères, no heating effects were perceptible during the two hours the lamp was kept burning. In another experiment a tube containing mercury formed part of the circuit, from the centre of which projected a much smaller tube, so that if the mercury expanded it would ascend into this smaller tube and form contact with a wire suspended from the top, and thus complete a local circuit, which was so arranged as to either ring a bell or shunt a portion of the main current if the temperature exceeded a certain limit. The results obtained by this arrangement were as follows:—

Ampères.	Distance between Wire and Mercury in small Tube at starting.	Time before Bell rang.
33·6	·125 of an inch.	15′
32	·250 ,,	45′
32	·375 ,,	140′
32	·5 ,,	

In the last case, at the end of six hours the mercury had not expanded sufficiently to reach the wire, consequently the bell did not ring. If it be a fact, as I believe it to be, that metal conductors charged with electricity fuse at a much lower temperature than that required to melt them when not so charged, how important it is that all the knowledge possible should be gained on the subject, especially by all interested in the distribution of powerful currents. That the electric light is to be the light of the not distant future no one acquainted with the subject can for one moment doubt. Of course it will require time for its development, but I must admit that the progress it has made within the last four years has astonished me. A great demand was suddenly made on a totally inadequate supply of practical men, and it was appalling to see how inexperience rushed in where experience feared to tread, the only wonder is that greater mischief has not been done to retard its progress. The desired experience, however, is being hourly and daily obtained, which must eventually lead to perfect success; for, in the language of Faraday, "such is the beauty of the manifestations that come before us when we deal with the great laws of nature and observe phenomena which never fail, because the Creator governs by fixed laws. He has permitted us to examine them and admire their effects and make provision for their application to purposes useful to man." In measuring the illuminating power of light it is customary to adopt the simple method suggested by Count Rumford, which consists in arranging the two lights to be compared so that each casts a shadow of some object on a white surface, and the eye has to judge as to the relative density of these shadows. The brightest light which casts the deepest shadow has then to be removed farther from, or the weaker one brought nearer to, the screen until the two shadows are pronounced equal in density; and the distance of the two lights from the screen being measured, the relative intensity of the lights is supposed to be as the square of the distances. But I found when comparing a standard candle with an incandescent electric light that the results differed in proportion to the distance the standard light was placed from the screen, and also that the variable state of the atmosphere influenced the results; again, the eye is not more to be depended upon for an estimate of light than the hand is for the weight of an object, particularly when any difference of colour may tend to perplex the judgment. I therefore am not surprised at the diversity of opinions often expressed as to the relative values of different lights. An accurate photometer or measure of light formed on other principles than that of the judgment of the eye would be a great *desideratum* at the present time.

Speaking of secondary batteries or accumulators, the President said: I know of no instance in which these batteries have gone beyond the experimental stage or accomplished anything that could not have been done by an ordinary battery; therefore we can only infer that they have not proved so successful as we were led to believe they would, and at the present time we must admit that the difficulty of storage has yet to be overcome.

All interested in the successful progress of submarine telegraphy must be pleased with the satisfactory advancement that branch of our science has made and is still making. Twenty years ago opinions differed as to the practicability of deep-sea telegraphy as much as they do at the present time concerning the ultimate success of electric lighting. The reasons asserted by even persons whose words carried a certain amount of authority against the possibility of ever successfully establishing long lengths of submarine cables were too absurd for sober record: "Unfathomable depths where, if a cable ever found a resting-place, the enormous pressure to which it would be subjected would destroy its component parts," "A cable would never descend beyond a certain depth," "There were in the ocean certain huge monsters which would devour the cable as rapidly as it was laid." Opinions as to the electrical difficulties in working such cables were as equally conflicting. At the present time, however, with but few exceptions, every civilised part of the world is telegraphically connected, the imaginary difficulties vanishing as submarine telegraphy advanced; for not only have cables been successfully submerged in great depths, but after many years have been lifted for repairs with as little difficulty as there was in laying them. It has also been proved that high speeds can be obtained with conductors of high resistance as compared with those first considered necessary. I believe electric lighting, which at the present time is engrossing so much attention, will progress in the same satisfactory way in the hands of competent and sincere workers.

The telegraph system of England under government management would, I believe, compare favourably with that under the control of any other government; but considering the disorganisation that occurs whenever we are visited with severe storms or strong electrical atmospheric disturbances there is yet much room for improvement in that direction. With a view to prevent such obstructions, both in France and Germany, the aerial lines are being superseded by subterranean wires, with, as I am informed, satisfactory results.

The telephone, in conjunction with that equally marvellous instrument, the microphone, is making progress as a telegraph instrument, but up to the present time only for comparatively short distances owing to its very sensitive nature. In experimenting with other telegraph instruments, it is, as a rule, sufficient to get at their working capacity by means of resistance coils; but not so with the telephone. I have heard distinctly with a telephone through a metallic circuit of two megohms, which was equal in resistance to 330 Atlantic cables, or 664,000 miles; but when the circuit was changed to a cable 68 knots in length, having a resistance of 670·5 ohms on one end of the telephone and a resistance equal to that of the cable on the other, the sounds received were very indistinct. On January 8th, 1880, Charing Cross and Cannon Street Stations were telephonically connected by two special wires suspended so as to be as far as possible from the influence of the ordinary telegraph wires. Notwithstanding the combination of noises generally heard in either of these stations conversation could be freely carried on; and I at Charing Cross heard distinctly the ticking of a watch which was placed on the instrument at Cannon Street. Greater wonders than this have been achieved with the same kind of instrument since that date, and I merely instance it as a fact in the early days of the microphone. As at present constructed the telephone is far too sensitive to compete successfully with other types of telegraph instruments, but it would be interesting to know at what distance they really would work on a circuit, either earth or metallic, placed far from any external influence. Owing to the inductive effects of submarine cables the distance would be comparatively limited.

The calls on the skill and inventive faculties of telegraph engineers and electricians have increased so rapidly, and are so numerous and multifarious, that I have found it impossible in the time allotted me this evening to do more than just touch upon a few of the most important.

In conclusion I would remark, especially to the younger members of this Society, that it has always been my endeavour to follow the advice of an author, whose name I have forgotten, but who wrote: "I find a frank acknowledgment of one's ignorance is, not only the easiest way to get rid of a difficulty, but the likeliest way to obtain information; and therefore I practise it. I think it an honest policy. Those who affect to be thought to know everything often remain long ignorant of many things that others could and would instruct them in if they appeared less conceited." The tendency of the present day appears to be to sacrifice much to the love of gain. We have an honourable calling; then let our endeavour and ambition be to guard it as such and in so doing "learn to labour and to wait" for that reward which is sure to crown the labours of the honest worker.

Physical Society.

PROFESSOR CLIFTON, President, in the chair.

New member, Mr. HUGH E. HARRISON.

PROFESSOR G. CAREY FOSTER read a paper on "The Determination of the Ohm," in which he described the various methods which have been used and proposed in determining the B. A. unit of resistance. He also described a method of his own, proposed in 1874, and recently tried with good results. The method consists in balancing the E. M. F. set up in a coil of wire by spinning it in the earth's magnetic field, against the E. M. F. of a battery or other electromotor in a wire whose resistance is to be determined. The two opposing circuits through this wire, R, are composed,

the first, of the spinning coil and a zero galvanoscope, and the second of a battery and an absolute galvanometer, these two circuits meeting at the ends of the wire, R. The late Mr. Hockin and Professor Foster find that the best conditions obtain when the resistance of the absolute galvanometer, r, is equal to R; the resistance of the zero galvanoscope, r, r_2, equal to $\frac{R}{2} + r_3$; and the resistance of the spinning coil, r_3, many times the battery resistance, which should be so low as to be practically negligible. The E. M. F. of the battery should be double that of the spinning coil. Many other conditions had to be attended to as explained by Professor Foster. With this method and using a thermo-electric battery giving an E. M. F. of 2·2 volts, the coil was spun at about 180 revolutions per minute. r_1 was 63 ohms; r_2 was 135; r_3 was 50; and R was 73 in one and 80 in another experiment. R was made up of coils in a resistance box. The ohm was determined by two trials to be 1·003 and ·999. This general result is so satisfactory that the experiments will be continued with extra precautions.

Mr. GLAZEBROOK called attention to the remarkable agreement between the results of Lord Rayleigh's determinations and his own independent ones. Lord Rayleigh's figures are for the unit ·9,893 ·9,865, ·9,868, and Mr. Glazebrook's is ·9,866, or the mean of Lord Rayleigh's results. He also announced that the Clarendon Laboratory, Cambridge, would soon be in a position to test and certify any resistance coils sent there.

Mr. WALTER BAILY then read a paper on "The Spectra Formed by Curved Diffraction Gratings." In a diffraction grating ruled on a portion of a cylinder, if r is the distance of a point from the centre of the grating, and θ the angle which a line to a point makes with the perpendicular from the centre of the grating, c, the radius of curvature of the grating, and d an arbitrary constant, a series of curves may be drawn in the plane perpendicular to the lines of the grating, having as the general equation—

$$r^{-1} \cos^2 \theta = c^{-1} \cos \theta + d^{-1}$$

If a source of light is placed on a point on one of these curves, all the foci of the diffracted light lie on the same curve. The curve consists of two loops, one of which gives the spectra of transmitted, and the other those of refracted light. When d is infinite these curves coincide in a circle, the properties of which have been used by Prof. Rowland in the construction of his diffraction spectroscope.

The paper also described how the position of the spectra on the curves could be determined for any position of the source of light.

REPORT ON ELECTRIC LIGHTING.

PRELIMINARY REPORT OF MR. CONRAD W. COOKE TO THE BOROUGH OF SHEFFIELD.

THE corporation of the borough of Sheffield having resolved to apply to the Board of Trade for a Provisional Order under the Electric Lighting Act of 1882, authorising them to supply electricity for public and private purposes within the said borough, and I having been requested by the Corporation of the said borough of Sheffield to advise them as consulting engineer with respect to the said Provisional Order, and the carrying out of the provisions therein contained, I beg to submit the following preliminary Report.

The application of the science of electricity to industrial purposes, especially to the production of artificial illumination, the transmission of mechanical power to a distance, and the allied industries of electro-plating and electro-typing has, during the last few years, made such important progress that it may fairly be said to have passed from the experimental region of the laboratory of the physicist to take its place among the recognised industries of the world; and the International Exhibition held at Paris in 1878, and still more emphatically the Exposition d'Electricité, which was held in the same city last year, have demonstrated to the public the practical capabilities of the application of electricity to illumination as well as to other hardly less useful industrial purposes. The result of these practical demonstrations has been that a strong and insatiable public demand for electricity has arisen, and a large and rapidly-increasing number of electrical installations has sprung up in every civilised portion of the globe, but especially in this country, in France, Belgium and Germany, and in the United States of America.

The lighting of a considerable number of the streets of Paris and London was quickly followed by other towns, and a new branch of industry has arisen out of this public demand of such magnitude that electric lighting companies with capital in the aggregate amounting to several millions of pounds have been formed in bewildering numbers, and the question has become of so much public importance as to demand the recognition of the Legislature. In August of the present year the Electric Lighting Act of 1882 was added to the statutes, and this was immediately followed by a set of rules issued by the Board of Trade with respect to applications for licences and Provisional Orders.

The immediate consequence of the passing of this Act was that the corporations of nearly all the important towns in the United Kingdom were applied to and served with notices from some five or six electric lighting companies, or other proprietors of systems of electric supply, of their intention to apply for licences or Provisional Orders for the establishing, in each of the towns applied to, electric power-generating stations, workshops, and machinery, with powers for the breaking up of the public streets and highways for the purpose of laying the conductors or electric mains, and for the doing of all such things as are necessary to the establishment of electrical installations upon a large scale.

The giving consent to the obtaining of Provisional Orders for such purposes to private companies or individuals would virtually amount to the abandonment of the rights of corporations and other local authorities to the control of the streets and highways within their own boroughs or districts over which they have had hitherto, and would have otherwise, control; and there has been a very general and very decided feeling on the part of corporations and other local authorities, to resist so serious an interference with their rights within their respective districts.

To prevent this interference there appears to be but one course open to the local authority of a borough or district, and that is (in accordance with Rule II. of the Board of Trade Rules), itself to apply for a Provisional Order to supply electricity within its borough or district, and thus maintain in its own hands the control of its streets and highways, and at the same time not place its town behind other towns in the adoption of electric illumination, which, at no very distant period must, in my opinion, be generally adopted for town lighting.

In order to comply with the requirements of the Board of Trade I am advised that, although it is open to the Corporation of Sheffield to apply for a Provisional Order specifying the area of supply to be the whole area of the borough as constituted under the provisions of the Acts relating to municipal corporations, it is not necessary to take compulsory powers for the whole of that area, but in order to show that the corporation has, in applying for an order, a *bonâ fide* desire to make a substantial trial of the electric light within the borough, and not merely to keep others from supplying electricity therein, it is necessary that the corporation, in applying for a Provisional Order, shall undertake, within a specified time, to give a supply of electricity for private purposes within a certain district of the town, such district not being necessarily very large, as compared with the area of the whole borough, but that, throughout that limited district, the undertakers must bind themselves to supply at a uniform rate of remuneration any intending consumer who may apply for it.

I would therefore propose that the corporation should, in connection with the Provisional Order, undertake to make an experimental lighting of a certain limited area of the town, and by "area" I do not mean an area, in the ordinary acceptation of the word, bounded by a circular or polygonal boundary, and embracing every house within it, but a selection of a few of the most important streets specified in a schedule to the Provisional Order, and not to include (except in instances likely to prove advantageous or desirable), the smaller streets and blocks of buildings included within the meshes formed by the network of streets proposed to be included in the district to be lighted.

I have prepared a plan indicating the district over which I would propose to supply electricity for private purposes, which might be distributed from a single supply station placed upon any land sufficiently near to the installation that could advantageously be obtained by the corporation, or preferably from two stations situated respectively at or near the opposite ends of the district to be lighted. The district I would recommend the corporation to illuminate (as a preliminary step, and in order to comply with the rules of the Board of Trade), embraces a series of streets extending, generally speaking, from north-east to south-west, that is to say, from the river end of Waingate, near to the Lady's Bridge, to the southern end of Pinstone Street, near to Moorhead and to Barker Pool, near the Albert Hall, and consists of the following streets and thoroughfares, the houses and other buildings belonging to which should be included in the area of compulsory supply:—

(1)	Waingate	(8)	Market Place
(2)	Castle Folds	(9)	High Street
(3)	Castle Street	(10)	Church Street
(4)	Angel Street	(11)	Leopold Street
(5)	King Street	(12)	Fargate
(6)	Old Haymarket	(13)	Barker Pool
(7)	Market Street	(14)	Pinstone Street

The above series of streets measures in the aggregate about a mile and a quarter, and represents rather over two miles of house frontage, about seventy-five per cent. of which is occupied by shops.

Leaving for future consideration the *public* lighting of the above district, I will confine myself to the illumination of the houses and shops which are directly belonging to the streets of which it is composed, and the first question which presents itself for consideration is whether the illumination shall be effected by arc lights or by incandescence lamps, or by a selected combination of the two. There cannot be a doubt that for large open spaces, for large halls, and for many factories and mills the illumination by the electric arc is the most convenient, as it is the most economical, but on the other hand

it is a system that requires a certain amount of skilled attendance, the lamps employed requiring to be fitted with new carbon pencils every day, and not only has this to be done, but certain adjustments have occasionally to be made to the lamps. These operations, though simple in themselves to any one accustomed to them, are such as would prevent my recommending any arc system for indiscriminate *private* lighting, for which purpose it is impossible for the apparatus within a private house to be too simple, being, as it is, more or less in the hands of shop assistants, domestic servants, and other unskilled people.

For the above reasons I am bound to recommend for the general illumination of the district the principle of lighting by incandescence, of which, as the corporation knows, there are several systems owned by as many proprietors. I would therefore recommend the laying out of the installation as if nothing but incandescence lights were to be employed, but I would, at the same time, point out that the doing so does not *necessarily* exclude the employment of arc lights in special cases where they might be more suitable, for it is quite possible—although I do not recommend it—to substitute an arc lamp for a corresponding number of incandescence lamps, and thus have both arc lights and incandescence lamps burning on the same circuit. I should prefer (if there were a sufficient demand for arc lights to justify the outlay), the laying of a separate circuit for them, actuated by a separate dynamo machine or series of machines, so that the one system would be perfectly independent of the other, but whether this should be done or not can only be determined by the extent of the demand and by other local circumstances.

The attendance required with incandescence lights is simply the turning them on or off, as required, and the renewal of lamps when destroyed, and as the average life of an incandescence lamp is upwards of a thousand hours, and its renewal is as simple an operation as putting a candle into a candlestick, the attention required by consumers is altogether inconsiderable, and does not even include any lighting operation except the turning on of a small tap-like "switch."

For uniform and steady illumination there is nothing to be desired in incandescence lights, they are perfectly steady, being subject to no fluctuation—which cannot be said of the very best arc lamp at present in the market—although all the arc lamps employed to any considerable extent at the present time are great improvements on those of but a few years ago, and I have no doubt that arc lighting will be still further improved by the introduction of regulating lamps still more readily adjusting themselves to the variations of the current transmitted through them, and side by side with these improvements the system of the self-adjustment of dynamo machines to the work put upon them from time to time will become more and more developed.

In order to arrive at anything like an accurate estimate of the amount of illumination required, that is to say, of the number of lights of a given photometric value that will be necessary to be supplied with electricity, I would suggest that the occupiers of premises belonging to the district to be lighted be asked the number of lights they would require (estimating at about eight electric incandescence lamps for every ten gas-burners at present employed), or if that be considered inadvisable, a reliable person might be requested to survey the district with the object of estimating, as nearly as possible, the number of gas-lights at present employed in the shops and other buildings attached to the streets mentioned in the schedule, and from an estimate so produced the number of equivalent electric lights might be computed.

In the absence of such information, and for the purpose of making a general estimate of what may be considered the requirements of the installation, I have taken an average number of houses throughout the district by considering every 24 feet run on each side of the street as representing one house, and upon this method of computing I take it that there are 550 average houses in the district. In a district consisting of private dwelling-houses and but few shops, it is fair to estimate that the illumination by incandescence lamps may be effected by allowing an average of ten lamps per house of an average frontage of 24 feet, upon which calculation there would be required 5,500 lamps. Inasmuch, however, as the district consisting of the streets set forth in the above list is composed, in so large a proportion, of shops likely to require a larger number of lights, it would hardly be safe to estimate a smaller number of lights per house than eighteen, which would bring the number of lamps for the district to 10,000. It is not in the least degree probable that every proprietor in the district would adopt the electric system at once, and we may assume that there will be a considerable number who will refuse to adopt it altogether. On the other hand there will be others (and I expect many among the proprietors of important shops) who will require a larger number of lamps than the estimated allowance of eighteen lamps for every 24 feet of frontage, and so the deficiency of some will be made up by the greater demand of others.

To drive these ten thousand lamps I estimate would require about 1,250 actual horse-power when all working together. This power estimated at about one-eighth of a horse-power per lamp is, I am aware, greater than that quoted generally by proprietors of electrical incandescence systems, who more often state that an average of ten twenty-candle lamps can be driven per horse-power, but I do not feel justified in recommending the adoption of a less driving-power than one horse-power to every eight lights; but this estimate is an outside one and should allow a margin for insuring easy working.

I would here point out that under most of the recognised incandescence systems the cutting out of lamps is accompanied by a corresponding saving of motive-power, and, therefore, of fuel consumed, so that if at any time 100 lamps be in operation, or 1,000, or 10,000, the power absorbed will bear a proportionate relation to the number of lights in actual operation.

It may be of some service if I in this place give a few figures by way of roughly estimating the capital required for such an installation, the items of which may be divided under three headings, that is to say:—

[I.]—PRODUCING OR GENERATING PLANT.
[II.]—DISTRIBUTING PLANT.
[III.]—FIXED PROPERTY.

[I.]—PRODUCING OR GENERATING PLANT may be divided into two sections:—

(1) *Motive-Power*:—
Consisting of (*a*) Steam-engines. (*b*) Boilers. (*c*) Steam and other fittings, shafting, &c.

(2) *Electric Apparatus*:—
Consisting of (*a*) Dynamo-electric machines. (*b*) Indicating, testing, and other accessory apparatus—such as switches, cut outs, meters, &c.

[II.]—DISTRIBUTING PLANT:—
1. Electric mains and conductors.
2. Distributing boxes.
3. House Service lines.

[III.]—FIXED PROPERTY:—
1. Land.
2. Buildings.

CAPITAL REQUIRED.

[I.]—PRODUCING PLANT:—

(*a*) Six 250 I.H.P. compound steam-engines, *i.e.*, five working and one in reserve, at £750	£4,500	
(*b*) Six Lancashire boilers at £780 ...	4,680	
(*c*) Pipes and connections	1,000	
(*c*) Fixing, &c.	1,000	
		£11,180
Twelve 1,000-light dynamo-electric machines at £800	£9,600	
Fixing, starting, &c.	1,000	
		£10,600
		£21,780
		£2 3s. 6d. per lamp.

[II.]—DISTRIBUTING PLANT:—

(*a*) 6,250 feet of streets with mains laid on both sides at £3,000 per mile	7,200	
(*b*) 60 distributing boxes at £8	480	
(*c*) 400 house service lines at £3	1,200	
	£8,880	£8,880
		£0 17s. 9d per lamp.

[III.]—FIXED PLANT:—

(1.) Land, (2.) Buildings } Estimated together at ...	£10,000	
		£10,000
		£1 per lamp.

[IV.]—To which may be added for contingencies, engineering, &c., at 10 per cent. £4,066
£0 8s. 2d. per lamp.

£44,726

Total capital £4 9s. 5d. per lamp.

(A).—The above figures are on the assumption that the boilers employed are of the ordinary Lancashire type, and the engines are compound high and low pressure non-condensing engines.

(B).—Should it be decided to adopt compound high and low pressure condensing engines, so as to effect the greatest possible economy of fuel with Lancashire boilers, the item for motive-power must be increased to 15,530, estimated as follows:—

Five 300 I.H.P compound engines—that is four to work and one in reserve—delivered and set at £1,700 each	£8,500
Foundations for ditto	900
Nine Lancashire boilers, seven working and two spare, delivered on setting at £450 each	4,050
Boiler settings	1,080
Pipes, floor-plates, &c.	1,000
	£15,530

(C.)—If, on the other hand, "locomotive" boilers be decided upon, in order to occupy a minimum of space and to be able to get up steam very quickly, the item for motive-power will become £16,700, made up as follows:—

Five compound engines, as above	£8,500
Foundations for ditto	900
Seven "locomotive" boilers at £870 each	6,090
Settings for ditto	210
Pipes, floor plates, &c.	1,000
	£16,700

SUMMARY.

(A) If compound non-condensing engines be employed—

Electric apparatus	£10,600	
Motive-power	11,180	
Distributing plant	8,880	
Land and buildings	10,000	
	40,660	
Contingencies, engineering, &c., 10 per cent.	4,066	
		44,726

(B) If compound condensing engines and Lancashire boilers be employed—

Electric apparatus	£10,600	
Motive-power	15,530	
Distributing plant	8,880	
Land and buildings	10,000	
	45,010	
Contingencies, engineering, &c., 10 per cent.	4,501	
		£49,511

(C) If compound condensing engines and "locomotive" boilers be employed—

Electric apparatus	£10,600	
Motive-power	16,700	
Distributing plant	8,880	
Land and buildings	10,000	
	46,180	
Contingencies, engineering, &c., 10 per cent.	4,618	
		£50,798

The above figures are further summarised in the following table:—

CAPITAL.	With Compound Non-condensing Engines and Lancashire Boilers. A	With Compound Condensing Engines and Lancashire Boilers. B	With Compound Condensing Engines and "Locomotive" Boilers. C
Electric Apparatus..	£10,600, = £1 1s. 2d. per lamp.	£10,600, = £1 1s. 2d. per lamp.	£10,600, = £1 1s. 2d. per lamp.
Motive-Power	£11,180, = £1 2s. 4d. per lamp.	£15,530, = £1 11s. per lamp.	£16,700, = £1 15s. 4d. per lamp.
Distributing Plant..	£1,880, = 17s. 5d. per lamp.	£8,880, = 17s. 9d. per lamp.	£8,880, = 17s. 9d. per lamp.
Land and Buildings	£10,000, = £1 per lamp.	£10,000, = £1 per lamp.	£10,000, = £1 per lamp.
Contingencies, Engineering, &c.	£4,066, = 8s. 2d. per lamp.	£4,501, = 9s. per lamp.	£4,618, = 9s. 3d. per lamp.
TOTAL	£44,726, = £4 9s. 5d. per lamp.	£49,511, = £4 18s. 11d. per lamp.	£50,798, = £5 1s. 7d. per lamp.

I will now consider the probable cost of working such an installation, inclusive of charges for management as well as for interest on capital, dividing these charges under four heads, viz.:—

[I.]—COST OF PRODUCTION.
[II.]—COST OF MAINTENANCE.
[III.]—COST OF MANAGEMENT.
[IV.]—INTEREST ON CAPITAL.

[I.]—PRODUCTION.

The cost of production is made up of three principal items:—

1. *Cost of coal.*
2. *Cost of oil, stores, &c.*
3. *Wages.*

COST OF COAL—

Taking the price of engine coal delivered in Sheffield at 7s. per ton, and estimating that the compound non-condensing engines with Lancashire boilers (A) will consume 2·7 lbs. of coal per horse-power per hour, we have an expenditure of £1,582 per annum.

If, however, condensing engines with similar boilers be employed, the cost for production will be less on account of the greater economy of working, they consuming but 2·3 lbs. of similar coal per horse-power per hour, the cost will therefore be £1,347 per annum.

The saving of coal is, however, to a certain extent neutralised by the extra cost of maintenance added to larger interest on capital by reason of the greater prime cost of the engines.

Lastly, by the employment of "locomotive" boilers—by which a great saving of space is effected, and steam may be got up in the shortest possible time—a still less quantity of coal per horse-power per hour is consumed, being at the rate of about 2 lbs., but it must be borne in mind that these boilers are not suited for burning ordinary engine coal, but require a more expensive fuel, such as Tanfield Moor or coal of similar quality, costing in Sheffield probably as much as nine shillings per ton, and here again the extra capital involved raises the cost of working and the interest to a price which unless a saving of space be of great importance hardly justifies the adoption of this class of boiler and engine. The cost of coal in this case would be £1,507 per annum.

OIL, STORES, &c.—

I now come to that item in the cost of production which refers to *oil, stores, &c.*, and this may be fairly estimated at about £4 16s. per week, or £250 per annum.

WAGES—

With respect to *Wages* the following staff will be sufficient to work such an installation as is referred to in this report:—

One electrical foreman at £12 10s. per month	£150	per annum.
Three engine drivers, each at £8 15.	315	,,
Six firemen, each at £6 10s.	470	,,
One boy at £1 15s.	21	,,
Total for Wages	£956	,,

Summarising the foregoing figures, we get the following results for the employment of the type of engine and boiler referred to in column A in the tabulated summary of capital given on the opposite page.

Coal	£1,582	per annum.
Oil and stores, &c.	250	,,
Wages	956	,,
	£2,788	,,

that is to say, ·178 pence for I.H.P. per hour, *i.e.*, ·022 pence per lamp per hour; or 5s. 6½d. per lamp per annum.

Employing type B of engine and boiler, we have the following cost of production:—

Coal	£1,347	per annum.
Oil and stores, &c.	250	,,
Wages	956	,,
	£2,553	,,

that is, ·163 pence I.H.P. per hour = ·02 pence per lamp per hour, or 5s. per lamp per annum.

With type C of engine and boiler, the cost of production will be as follows:—

Coal	£1,507	per annum.
Oil, stores, &c.	250	,,
Wages	956	,,
	£2,713	,,

that is, ·174 pence per I.H.P. per hour = ·022 pence per lamp per hour, or 5s. 6d. per lamp per annum.

[II.]—MAINTENANCE.

The expenses of maintenance of an electric lighting installation are made up of the following items:—

(1) *Repairs of buildings,*
(2) ,, *electric apparatus,*
(3) ,, *engines and boilers,*
(4) ,, *distributing plant.*

and these I would estimate at about 5 per cent. per annum on the first cost respectively of the buildings and distributing plant, and 10 per cent. on that of the electric apparatus and motive-power.

Upon this principle if estimation the following will be the cost of maintenance if the installation of type A of engine and boiler be adopted:—

Repairs on £5,000 buildings, at 5 per cent. ...	£250	per annum.
,, £10,600 electric apparatus, at 10 per cent.	1,060	,,
,, £11,180 engines and boilers, at 10 per cent.	1,118	,,
,, £8,880 distributing plant, at 5 per cent.	444	,,
	£2,872	,,

which is ·184 pence per I.H.P. per hour, or 0 23 pence per lamp per hour, or 5s. 9d. per lamp per annum.

Employing type B of engine and boiler we have the following cost of maintenance:—

Repairs on £5,000 buildings, at 5 per cent. ...	£250	per annum.
,, £10,600 electric apparatus, at 10 per cent.	1,060	,,
,, £15,530 engines and boilers, at 10 per cent.	1,553	,,
,, £8,880 distributing plant, at 5 per cent.	444	,,
	£3,307	,,

= ·212 pence per I.H.P. per hour, or ·026 pence per lamp per hour, or 6s. 7d. per lamp per annum.

With type C of engine and boiler the cost of maintenance will be as follows:—

Repairs on £5,000 buildings, at 5 per cent. ...	£250	per annum.
,, £10,600 electric apparatus, at 10 per cent.	1,060	,,
,, £16,700 engines and boilers, at 10 per cent.	1,670	,,
,, £8,880 distributing plant, at 5 per cent.	444	,,
	£3,424	

i.e., ·219 pence per I.H.P. per hour, which is at the rate of ·028 pence per lamp per hour, or 7s. per lamp per annum.

[III.]—MANAGEMENT.

For the cost of management the sum of £500 may safely be assumed to cover all outlays under this head upon an installation of 10,000 incandescence lamps.

£500 per annum = ·032 pence per I.H.P. per hour, *i.e.*, ·004 pence per lamp per hour, or 1s. per lamp per annum.

INTEREST ON CAPITAL.

Employing type A of engine and boiler, we have:—

Interest on £44,726 at 5 per cent. = £2,236 per annum, or ·143 pence per I.H.P. per hour, *i.e.*, ·018 pence per lamp per hour, or 4s. 6d. per lamp per annum.

With type B of engine and boiler the capital being larger the interest is proportionately increased.

Interest on £49,511 at 5 per cent. = £2,475 per annum, which is ·158 pence per I.H.P. per hour, or ·02 pence per lamp per hour, or 5s. per lamp per annum.

If type C be employed the annual cost of interest on capital per lamp is about the same, thus:—

Interest on £50,798 at 5 per cent. = £2,540 per annum, or ·162 pence per I.H.P. per hour, *i.e.*, ·02 pence per lamp per hour, or 5s. per lamp per annum.

Summarising the above figures in a tabular form, we have the following table of the cost of working the installation, with the three types A, B, and C respectively of engine and boiler.

Working Cost.	Cost per lamp using compound non-condensing engines and Lancashire boilers, consuming 2·7 lbs. of coal (at 7s.) per I.H.P. per hour		Cost per lamp, using compound condensing engines and Lancashire boilers, consuming 2·3 lbs. of coal (at 7s.) per I.H.P. per hour.		Cost per lamp, using compound condensing engines and "locomotive" boilers, consuming 2 lbs. of coal (at 9s.) per I.H.P. per hour.	
	Per hour.	Per annum of 3,000 hours.	Per hour.	Per annum of 3,000 hours.	Per hour.	Per annum of 3,000 hours.
	pence	s. d.	pence	s. d.	pence	s. d.
Production	·022	5 6½	·02	5 0	·022	5 6
Maintenance	·023	5 9	·026	6 6	·028	7 0
Management	·004	1 0	·004	1 0	·004	1 0
Interest on capital at 5 per cent ...	·018	4 6	·02	5 0	·02	5 0
Total cost	·067	16 9½	·07	17 6	·074	18 6

The above figures (which do not include the cost of water for the boilers) indicate that the saving of coal effected by the adoption of condensing engines is not so great as the increase of working cost, due to repairs and interest on capital for an installation of this size, in a town like Sheffield, where coal can be had at an exceptionably cheap rate, and when it is considered, moreover, that, added to the above working cost, there must be a considerable item for the supply of condensing water, I do not feel justified in recommending the adoption in the present case of condensing engines, although in my opinion for very large installations, such as will be required when electric lighting for public and private purposes becomes general, there will be a most decided advantage in the employment of the most economical motive-power, even in places where coal is cheap.

It must be noted that the capital expenditure and working cost mentioned in this report are calculated on the assumption that the whole number of ten thousand lights are in action during the whole year's working of three thousand hours; or, in other words, that the producing plant has an annual demand upon it of thirty million lamp hours; but this result can hardly by any possibility be attained in practice, and I should consider that the average would not exceed half that amount, for the number of lights in operation at any one moment depends upon a number of individual and local circumstances. Thus in a district (such as that proposed to be lighted in Sheffield) consisting mainly of shops and houses of business, there will be great differences in the period during which the lights of different establishments will be in operation. For example:—Some shops shutting up at 6 o'clock would turn out their lights about 6.15, many close at 8, and a large number at 10, while some remain open still longer. Banks, on the other hand, would shut off at 5 or half-past, and thus, during the winter, while some might keep their lights running as long as nine hours, others would be cut off after only one hour's working. Again, on Sunday, that is for a period equal to one-seventh of the year, or nearly 430 working hours, very few if any lights would be used in shops or houses of business, and the number would be reduced to what was required for domestic purposes. On the other hand, on dark, foggy days, and in places poorly lighted by day-light, the lights might be required during the whole, or for a large portion of the day, and in some establishments they might be kept going all night. All these considerations show that the demand upon the producing plant at any one time would be very different in different places, and also that it would be very variable from hour to hour.

Against, however, such exceptional demands must be set the fact that during the summer months the lights of some of the largest establishments would not be in use at all, while in all the duration of burning would be reduced as the length of the days increased, and thus the annual working cost would be proportionately reduced.

There must moreover be expected to be some variation in the number of lights in operation in any one establishment. For example, in shops in which work is carried on after the establishment has been closed to the public, the lamps illuminating the windows and shop front would be shut off earlier than in the rest of the building; but it will be readily understood that the larger the installation driven from one connected system of conductors, whether deriving their electricity from one or more than one producing station, the more uniform will be the demand and the closer will it approximate to an average constant. Taking all these considerations together, I am inclined to think that, except on rare occasions affecting the whole community alike, such, for example, as a general illumination on an occasion of public rejoicing, there would never occur an instance of all the lamps being in action at the same time for many hours together.

I have in the earlier part of this report recommended the employment of electric lighting by incandescence for the *private* lighting of the district, for the reasons already stated. It must, however, be a matter for the subsequent consideration of the corporation whether it will be advisable on their part or not to recommend to consumers the employment of any one system of incandescence lighting or special form of lamp. Of these there are four principal kinds, named respectively after their several inventors—the Swan, the Edison, the Lane-Fox, and the Maxim—each possessing distinguishing characteristics of its own. It is, however, contrary to the provisions of the Electric Lighting Act of 1882, as it exists at the present date, for the corporation, as undertakers, to specify or insist upon the consumers employing any particular form of lamp. On the other hand, it is highly desirable in the interests of the consumers, as well as for the success of the undertaking that no apparatus be employed by consumers that shall either through failure or otherwise bring discredit on the undertaking.

To meet this, I would propose that the corporation, without in any way insisting on the employment of any special lamp, should encourage the adoption of a lamp best suited to the installation, either by offering certain advantages in the supply or putting up of such lamps, or by the entering into of an arrangement with certain firms, local or otherwise, for the supply and fitting of those lamps which in the opinion of the corporation are most suitable; such firms agreeing to supply and fit lamps at a price advantageous to the consumer, in consideration for the recommendation and general guarantee of the corporation. It would in all cases be necessary to make it a condition of supply that no lamp or appliance of any sort be employed by a consumer that has not been previously approved of by the corporation or its scientific advisers. A provision of this sort made solely in the interests of the general body of consumers could not be, in the smallest degree, contrary to the spirit of the Electric Lighting Act, or of the rules of the Board of Trade, and would, I believe, meet with general approval. It is, moreover, a condition applicable and necessary alike to all systems of lighting in which a community of consumers is supplied from a common centre, and therefore is as necessary for gas lighting as for electric illumination.

I would also point out that both the capital and that portion of the working cost which is derived therefrom, such as maintenance and interest, have been estimated from manufacturers' prices. It is probable, however, that with the keen competition which must accompany the extended adoption of electric lighting, such prices may be reduced or considerable discounts allowed, thus reducing both the capital required and the cost of working.

CONRAD W. COOKE.

5, Westminster Chambers, London, S.W.
November, 1882.

THE ELECTRICAL LABORATORY AND WORKSHOP OF MR. LOUIS J. CROSSLEY, MOOR SIDE, HALIFAX, YORKSHIRE.

OUR readers will remember that during the early part of last year, a prize was offered through our columns for the best design for an Electrical Laboratory and Workshop. A large number of competitors sent us their plans, some of them being very excellent productions. In order that justice might be done to the competitors, we laid the plans before a small committee of leading electricians, requesting them, after very careful consideration, to select the best.

Although we were not at liberty at the time to state who had instructed us to offer the prize, it is now pretty well known to have been Mr. Louis J. Crossley, of Halifax, who has been taking a deep interest in electrical science for the past twenty years; and who is more recently known to our readers as the inventor of the transmitter bearing his name, and which we described in the columns of this journal, May 1st, 1879.

Mr. Crossley's original idea was to build the laboratory apart from his house—somewhere in the grounds adjoining—but ultimately it was decided to attach it to one end of the house, as shown in our sketches supplied with the present number.

This alteration rendered it impossible to carry out in their entirety the plans selected, or indeed any of the others sent in, a new arrangement having to be made to suit the ground, and it was carried out by Mr. John Ely, of Messrs. Salomons & Ely, architects, Manchester.

In a laboratory of this nature, several important items have to be taken into account in arranging the positions and laying out the various rooms.

The electrical laboratory, for instance, must be as far away as possible from the workshop, both on account of the vibrations of the machinery and also on account of the dynamos.

The room must also be sufficiently large to permit of electric light experiments being made, and must have facilities for suspending lamps and for making photometric measurements. There must be suitable stands for galvanometers and electrometers. All wires must be so laid as to be out of the way and at the same time easy of access. All these and many other minor points appear to have been taken into account, and to have been most carefully carried out at the Moorside laboratory.

As will be seen from our special supplement, a trough runs under the floor from close to the dynamo bed in the workshop, through the chemical laboratory to one side of the electrical room, this trough being supplied with the four boxes shown in the plan. The ends of the wires at the dynamo end are brought up to a test-box, which is also the case in the electrical room, and by means of which connections are easily made. Running down the east side of the same room a table or counter is fixed, with cupboards and drawers, while the top serves to carry a most complete equipment of resistance coils, ampère and volt-meters, graduated wire "bridges," and every other instrument necessary for making electrical measurements.

Over this table are two massive stone shelves, which are built into the wall and on which rest respectively the Thompson electrometer and galvanometer, the latter being a very fine instrument by Messrs. Siemens Bros., on the Jacobs system, by which means the reflection from the mirror is brought on to a ground-glass screen which is placed in front of the operator. A similar arrangement is also attached to the electrometer.

At the south end of the room another shelf serves to carry a transit theodolite, the window here being specially constructed to enable transit observations to be made.

Suspended from the beams and running down the middle of the room, overhead, is a plank, to which are attached fixtures for carrying arc lamps, together with a neat rack arrangement for holding incandescent lamps. The wires for these lamps being led over the plank, which is easy of access, a very convenient method for experimenting with different lamps is formed.

In addition to the foregoing, this room has many other neat arrangements for facilitating experiments, which render it a most convenient electrical laboratory; and it is almost unnecessary to add that a finer equipment of apparatus we do not remember to have seen, which at the same time is not so much to be wondered at, seeing that here is a collection of apparatus acquired during a period of over twenty years, and without much regard as to expense, &c.

We next come to the chemical room, which has a good arrangement of benches, cupboards, shelves, &c., with the usual collection of balances, bottles, measures, and the hundred and one other things usually found in a well-arranged laboratory. This also serves the purpose of a battery room.

Leaving the chemical laboratory, we come to the workshop, and here we find machine tools which would do credit to any of our telegraph instrument factories, the whole being driven by one of Crossley's "Otto" gas-engines of 6 H. P. nominal.

In addition to a 9-feet bed screw-cutting lathe, is a small foot lathe, capable of being worked either by foot or power; also a neat form of milling machine and a bandsaw, together with other tools too numerous to mention in the limited space at our disposal.

In this room a couple of dynamos are fixed on a somewhat novel form of iron bed laid down on concrete and ashlar insulated with asbestos. The iron bed is drilled and cut away in such a manner that in changing dynamos which may be undergoing experiment, it is only necessary to lay the dynamo down on the bed, move the pulley in line with the driving cone, and screw down with the movable bolts and clamps in the bed.

Running from the laboratory to one of the mills of Messrs. John Crossley & Sons, Limited (about two miles by wire), is a No. 9 B.W.G. copper wire, which serves to convey the current from a 16-light Brush, or a large Gramme machine, either to use as additional power in the workshop or for the tramway outside, or otherwise as may be required.

If more extensive electric light experiments are desired than those which can be made in the electrical room, every convenience is found in a lighthouse fixed on the top of the house, and shown in the drawing between the wind gauge and the chimney. This lighthouse contains a very fine holophotal lens of 15° divergence, which is shown in elevation and section on the plan.

The lens is enclosed in a lantern which is fixed to the top of a cast-iron pillar, round which it can turn freely. The top of the pillar carries a brass circle graduated to 360°, while at one side of the lantern carrying the lens and lamp another graduated circle is fixed. From this it will be seen that the horizontal and vertical movement of the lantern can be accurately measured, and the bearings of any object taken by means of the theodolite during the day can be found at night by simply obtaining the same reading for the horizontal and vertical angles of the lantern. Mr. Crossley has measured and noted the directions and distances of the most prominent objects obtainable from the lighthouse, and when any one is required, it is only necessary to refer to the table fixed alongside the lantern. It has been found that with a medium sized Siemens machine and the holophote, a light can be directed with sufficient accuracy to enable a person at a distance of one and a half miles to read a newspaper.

In addition to this somewhat novel but at the same time highly interesting electrical application, there is another scarcely less novel—viz., the tramway already named. In our supplement will be found a sketch of this with Mr. Crossley and some of his children. The car consists, as shown, of a Siemens machine mounted upon a bed on wheels, the two rails and the wheels completing the circuit through the machine. The line is laid on asphalte, having a gradient of 1 in 25, and being about 105 yards long. The Siemens machine, with the carriage on which it is mounted, weighs about 3 cwt., and with two trucks eight people can be pulled up the incline at about eight miles an hour. In order to obtain more efficient contact a copper tape is to be laid down the middle of the track instead of depending entirely on the rails, when, no doubt, even a better result than the foregoing will be obtained.

The wind gauge seen on the top of the house is provided with contacts for sending reverse currents, which work a Wheatstone counter* fixed in the electrical room. By this arrangement winding up the indicator is avoided, and false readings due to the cups of the wind gauge "backing," and thus sending an extra current are also eliminated.

We may add that the machinery in the mechanics' shop was made by Darling and Sellers, of Keighley.

ON TESTING DYNAMO-ELECTRIC MACHINES.

WE recently stated in the course of some remarks on the Elphinstone-Vincent machine that we could not take certain tests which had been made as reliable, because the external resistance employed was a bath of acidulated water. Mr. Mudford, the electrician to Messrs. Paterson and Cooper—at whose works these machines were manufactured—takes objection to our statements and asks why we doubt the veracity of the figures given. Mr. Mudford is quite right in saying that a simultaneous reading of ampères and volts allows us to calculate the energy *given out*, and if the matter had ended here nothing need have been said.

But these readings also enable us to arrive at the resistance in circuit, and it is here that our remarks were really applied.

What we wish to arrive at is this:

How does Mr. Mudford know that the electrical efficiency of the machine is 82·9 with an *external* resistance of ·39 ohms? The resistances of the armature and field electromagnets are known, but it is evident that the water (external) resistance has been calculated, and this calculation cannot be strictly accurate unless the counter-electromotive force set up by the bath is noted. Mr. Mudford does not appear to have done this, and therefore we can only conclude

* Described in TELEGRAPHIC JOURNAL, vol. I., p. 4.

that the results of efficiency given are not absolutely correct, although they may be approximately so. However, we require something more than mere approximation in the present day to allow of expressing a decided opinion as to whether A's machine is more efficient than B's.

Let us imagine, say, ten cells connected up through an external wire resistance of 1 ohm. Say that each cell has an electromotive force of 1·5 volts, and an internal resistance of ·1 ohm, the current passing will then be 7½ ampères through an external resistance of 1 ohm. Now, suppose we insert, unwittingly, in the place of the wire resistance, a cell opposed to the rest, with an internal resistance of 1 ohm, and with the same electromotive force as the others, our current is then only 6¾ ampères through a resistance (apparently) of 1 ohm. We have only substituted one resistance for another, but in the second case we have a counter-electromotive force to deal with. We therefore must again point out, that in testing a dynamo-electric machine—otherwise than by placing it in circuit with arc lamps, where an opposing electromotive force necessarily arises—it is advisable that there should be nothing but *resistance* in the external circuit if the tests are to find acceptance. We believe that the late Sir Charles Wheatstone devised an apparatus for so rapidly reversing the polarities of the electrodes in any liquid that trustworthy tests of the resistance of the bath were assured, but of this we are not quite certain. Nothing of the kind appears to have been done in regard to the Elphinstone-Vincent machine, and our remarks were made solely with the view of pointing out a possible source of error in stating the efficiency *at a given speed* of what should be a machine of more than ordinary merit. The use of a water resistance would be still more objectionable with machines of low electromotive force.

GAS-ENGINES AND THE ELECTRIC LIGHT.

ONE of the difficulties involved in the production of the electric light by the aid of gas-motors appears to be practically solved by the "Special" engine made by the Victor Gas-Engines Company, an illustration of which we give.

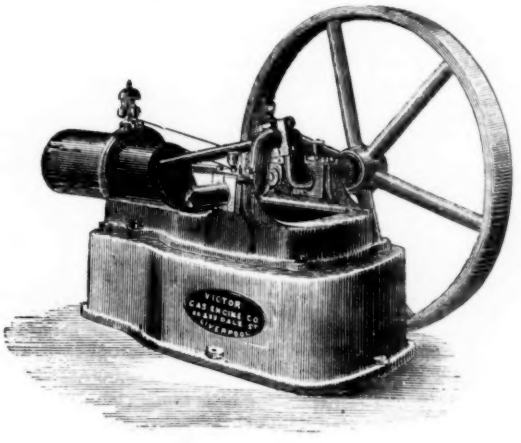
The well-known irregularity of motion of gas-engines of the type best known, consequent on an explosion having to impart sufficient power or impulse to the fly-wheel on the one outstroke to enable it to not only maintain itself in motion, but also to give off power to a dynamo during one entire revolution and part of another. Nor is this all, even the stored-up power in the fly-wheel is the most largely drawn upon at a time just previous to the next possible explosion, as during the instroke previous a very considerable back pressure, due to the compression, is present. Therefore such engines as make two complete revolutions for each possible explosion cannot possibly run perfectly steady. The "Victor Special" is, however, designed to meet the want of a gas-engine giving a perfectly steady series of revolutions, so that the electric light would be practically a steady one as far as the engine duty is concerned.

As will be seen by the illustration, the engine is of horizontal form, greatly resembling many well-known makes of steam-engines. The whole being mounted on a substantial cast-iron base so that the engine is entirely self-contained, needing no fixing beyond bolting to the floor; and it is most compact and simple.

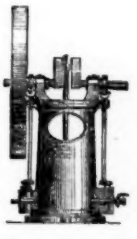
In order that the speed shall be perfectly regular the engine, when fully loaded, or when running a dynamo, is made to take explosions to every outstroke or revolution, so that the same amount of power is uniformly and regularly applied; and this result is greatly influenced by the peculiar composition of the charge, which is, we believe, different from that of other engines, it being made not to impart a sudden blow or shock to the piston, which would infallibly produce irregularity of running, but so constituted that the pressure is steady and well maintained to nearly, or quite, midstroke. This mode of constituting the charge is due to the unique action of the governors and throttle, or, we should say, gas valve. At the same time should the circuit be suddenly opened, from any cause, the governors have such ample control that the regular working speed would not be exceeded, although the entire load might be suddenly removed.

Amongst other peculiarities we may mention that the space taken up by the engine is unusually small. This, and the short overhang of the cylinder, is due to the fact that the piston travels the entire length of the cylinder instead of there being, as usually, a chamber at the back end not so traversed by it, as also to the fact that the charge is fired at a point close to the piston.

The consumption of gas and oil is very moderate, an engine now running is said to burn but 17 feet of gas per nominal horse-power per hour; whilst the lighting apparatus is so arranged that the valve very seldom requires cleaning—



an engine having been at work since April last without the need of valve or piston cleaning. As far as details of construction go, all parts are of ample strength and are thoroughly well finished; the idea being to produce an engine which should give a steady speed, need the minimum of attention, and be free from requiring repairs, so that it might be safely left to run by itself for considerable periods. The piston also is efficiently and automatically lubricated whilst in motion, and the supply of oil is entirely stopped when the engine comes to a state of rest.



The prices are very reasonable indeed. The engine is also reversible, thus running equally well either way at will, which will no doubt be found a novel and valuable addition in many circumstances, and a feature possessed by no other gas-engine as far as we are aware. The engine is easily started, with equal facility whether hot or cold. At our request, an engineer friend of ours paid a special visit to the company's premises in order to see one of these engines in action, and his report to us is very favourable. The engines can be made to any required power, and being well designed and of simple construction, with a minimum number of parts, we predict for them a most successful future. The material and workmanship are excellent.

The second illustration represents the "Little Victor" engine, which will be found useful and simple for employment with a few incandescence lamps.

Personal.—Sir Charles Bright and Mr. Edward Bright have resigned the offices they have held with the British Electric Light Company, the former as consulting engineer, the latter as a director.

LEGAL.

The United Telephone Co. v. Harrison, Cox-Walker & Co.

THE hearing of this appeal, which is by the defendants, Messrs. Harrison, Cox-Walker and Company from so much of the judgment of Mr. Justice Fry as held the telephone receivers manufactured by them to be an infringement of Prof. Graham Bell's patent of 1876, was resumed before the Master of the Rolls and Lords Justices Lindley and Bowen, in the Court of Appeal of the High Court of Justice on Friday of last week.

Mr. Hemming, Q.C., and Mr. Goodeve appeared for the appellants, the defendants in the recent action, and Mr. Aston, Q.C., Mr. Webster, Q.C., and Mr. Moulton for the respondents, the plaintiffs in the action.

Mr. Hemming, continuing his arguments for the appellants, minutely examined the specification to show that Bell nowhere claimed as his invention a plate of iron fastened all round for the purpose of obtaining the required vibration as distinct from a plate of iron, or any other armature, fastened at a particular point. At the time Prof. Bell took out his patent neither he, nor anybody else, saw any distinction of principle between the receiver which he described and the receiver which had been in existence before. The true construction of the specification, he maintained, was that that part which related to the circular disc was a general description, and the specification set up a general claim to a receiver consisting of an electro-magnet with an armature not confined to a particular form or a particular method of attachment. The accounts of persons who were present at the meeting of the British Association at Glasgow went to show that the instrument exhibited there by Sir William Thomson was the same as that referred to in the specification.

Mr. Aston held that the instrument made public at Glasgow was a receiver materially different from that which Bell claimed when he took out his patent in 1876.

Mr. Hemming went on to argue that the mode of mounting was a mere matter of convenience, and that mounting all round was not essential to the working of the instrument in any way whatever; and what he submitted was that what the patentee had to show was not merely that he could pick out from the specification something to indicate that the plate was to be fastened all round, but also that he had substantially explained to the public that that was what he described.

The Master of the Rolls: He is not obliged to point out anything to the public except that he has a new instrument, and that such and such is its description.

Mr. Hemming: When the novelty consists only of one little element, say the mode of fastening the disc, I submit he would be bound to make it reasonably clear to any one reading his specification that such was what he claimed as his novelty.

The Master of the Rolls: Whilst it is an entirely new instrument he may say, "I have invented a new instrument," and describe it and claim it. He may also say, "I claim half the instrument," but he is not obliged to tell the public what part he claims exactly.

Mr. Hemming: If he claims only a combination then it may be that he could hold his patent for the combination against any one who took the whole combination. As a matter of fact our receiver is not mounted the same as his.

The Master of the Rolls: Does he claim the receiver, and if he claims the receiver have you taken it in substance?

Mr. Hemming: He cannot say we have taken any part of it, unless he says we have taken his mounting.

The Master of the Rolls: The question is what is it that is claimed. I understand the receiver is claimed. I do not understand there is any separate claim in the mode of mounting.

Mr. Aston: Nor do I so contend.

The Master of the Rolls: When a man makes a new instrument you cannot make that instrument or its mechanical equivalent. If you have taken his invention in substance, either by copying it or using its equivalent, then you have infringed. There is no difficulty about it.

Mr. Hemming contended that supposing there was no part of the receiver new, and Prof. Bell had not said there was a single portion of it new, then there was no infringement. So far from being a new instrument it was simply an old instrument with wholly immaterial variations. At the time Prof. Bell took out his patent neither Prof. Bell himself nor anybody else saw any distinction of principle whatever between the receiver he described and the receivers which had been in existence before; and the mounting of the plate all round was not suggested as a distinction at the time he took out his patent. The construction of the whole specification was very material, not only as bearing on the alleged infringement, but also on the anticipation; and he submitted that the true construction of the specification was that it was a general description and a general claim of a receiver consisting of an electro-magnet with an iron armature, not limited or confined to a particular form of mounting. Two illustrations of the mode of mounting were given, and the specification claimed neither the one nor the other nor both. The mounting was perfectly well known at the time the patent was taken out, and if there was any infringement, the specification must so be read that it would cover almost every possible electro-magnet with an armature of any kind. He maintained that the instrument that was made at Philadelphia for Sir William Thomson by Prof. Bell's orders was made exactly like the Philadelphia instrument, that the disc was the same as that of the Philadelphia instrument, but that in order to prevent it being lost, it was fastened to the magnet with a screw. The putting in of the screw was the simplest thing in the world, and the tilting up of the one side of the disc was, he contended, not a part of the construction at all, but quite accidental. The thing that would be material for the plaintiffs to prove was that the tilting up of the disc of the instrument exhibited at Glasgow, to the understanding of competent instrument makers, signified that it was a part of the construction, but the instrument makers all asserted, without the slightest hesitation, that in their opinions it was no part of the construction.

The further hearing of the case was here adjourned till Saturday; and on that day,

Mr. Hemming, resuming his statement, read extracts from the evidence taken before Mr. Justice Fry, to show that the instruments exhibited at the Philadelphia Exhibition and the British Association at Glasgow were made with an all-round fitting disc, that the screw was put in merely to hold it in its place, and that the tilting up which caused the reed-like vibration, was the result of accident brought about by the handling of the instrument by visitors curious to see what was in the cylinder beneath. There was no ground for presuming that it was likely to have been in nearly so bad a condition as it was now as presented to the court. It was tried in the court below, but now it had got so disordered that it was a difficult thing to make it work. His conclusion was, that the receiver for which the patent was claimed, was discovered at Glasgow; and he maintained that with an efficient transmitter, which he admitted Professor Bell was the first to introduce, the receiver would work whether the disc was lifted up at one side or placed in contact with the rim of the cylinder; there was no difference in efficiency either one way or the other.

The Master of the Rolls said the court would require that matter to be determined by actual experiment.

Mr. Hemming stated that the appellants would be extremely glad of the opportunity, but suggested that the receiver should be tried by other transmitters as well as the Bell transmitter, which although a very good instrument was feeble in power.

The Master of the Rolls was of opinion that the experiments should be tried first with the Bell transmitter and then with other transmitters. As the case might go to the House of Lords, it would be desirable that a model should be made of the Glasgow instrument for the purpose of the trial, in order that the original might not be exposed to the risk of any alteration in its condition.

This was agreed to.

The Master of the Rolls then asked if he was to understand that the plaintiffs in the action claimed the right to every instrument which contained a plate in close juxtaposition to an electro or permanent magnet?

Mr. Aston: If the plate is as shown in the drawings.

The Master of the Rolls: But it is not shown.

Mr. Aston replied that the witnesses had stated that the drawings conveyed to their minds that a thin steel plate was fixed in juxtaposition relatively to the magnet, so that the undulations of the plate affected the magnet.

The Master of the Rolls: You claim any plate fixed anyhow?

Mr. Aston: There are two ways in the drawings in which the plate is fixed.

The Master of the Rolls: I understand all you require is that the plate should be kept over the magnet at a given distance?

Mr. Aston: That is what my friend says, but we do not agree to that. We claim a thin steel plate in combination with a magnet, whether electro or permanent, as long as it is brought in contact with the frame.

The court then adjourned, and—

On resuming on Monday morning,

Mr. Hemming explained that everything was now in readiness for the experiments their lordships had desired; and the court agreed to at once proceed with them.

The object of the experiments was to show whether or not the novelty of Professor Bell's invention was confined to the transmitter which has now been superseded. A number of instruments were adjusted and made to speak to the Judges by means of Hunning's transmitters operated upon in an adjoining room. The instruments used comprised certain models of the receiver exhibited at Glasgow; an instrument said to be a model taken from a diagram of a German invention of the receiver of an instrument by which musical sounds were transmitted to a distance, but which never transmitted articulate speech: a new instrument with a short, thick reed for "armature;" one with a common tuning fork for armature; and another instrument made from one of the diagrams in the plaintiffs' specification. The experiments occupied the whole of the morning, after which,

Mr. Hemming continued his address on behalf of the appellants, and argued that they could not be attacked in respect of the Hickley instrument at all. The instrument they manufactured was the Cox-Walker; they did not make the Hickley. At some time or another, however, they wanted some more instruments, and bought some Hickley's, and re-sold them. That, he maintained, could not possibly constitute an infringement of the patent. They did not want to make the Hickley instrument, and all that the plaintiffs could prove was that they had sold a Hickley.

Mr. Aston: From their advertisement we do not know whether they are advertisers of the Hickley alone, of the Cox-Walker alone, or of both.

Mr Hemming: There is no doubt we did not manufacture the Hickley.

Mr. Aston: I do not know that; there is no evidence to prove that you did not.

Mr. Hemming: And there is no evidence to prove that we did.

Mr. Aston: No.

The advertisement referred to was here handed to the Master of the Rolls, who, after perusing it, gave it as his opinion that there was nothing in it to show that the appellants did not manufacture the Hickley, but that it would rather lead the public to suppose that they did.

Mr. Hemming, in consequence of his lordship's expression of opinion on this point, went on to argue, and contended that the

evidence proved, that the patent was bad on the ground of anticipation.

Mr. Goodeve having briefly addressed their lordships, the arguments of the counsel for the appellants were closed, and the court adjourned.

On Tuesday morning,

Mr. Aston opened the case for the respondents, and said, in reference to the instrument exhibited in Glasgow prior to the patent, it would be necessary for their lordships to take into their consideration what was the state of the public knowledge at the time when the experiments at Glasgow were made, and what was put into the possession of the public by what was done at Glasgow. The patentee did tell Sir William Thomson something, which might be said to constitute the patentee's invention; but Sir William Thomson, who was the mouthpiece of the inventor, did not represent to his audience at Glasgow that which constituted the invention that Professor Bell had described and claimed, nor, in exhibiting the instrument which he did exhibit, did he exhibit anything which anticipated the patent. In September, 1876, when this address was given, neither the person who delivered the address, nor the audience who heard it, neither the exhibitor of the apparatus nor the persons who inspected it, knew how it was to act. Professor Bell's invention was an arrangement by which not only selected tones were taken up by something that would affect an electric current, but by means of which all the tones of the human voice, whether corresponding to notes or not could be taken up by something that would affect in a corresponding manner an electric current passing along a line wire, and would at the receiving end of that line wire affect a corresponding recipient so as to reproduce not selected tones but all tones that came to it as transmitted along the line wire. And what was the character of that which Prof. Bell proposed to employ? It was a plate which should have a tympanic vibration in contradistinction to a reed which would have a tongue vibration. He asked their lordships to hold, upon the evidence, that the Cox-Walker receiver harped back on the old incomplete selective principle, and was not at all constructed so as to act on what he had called the tympanic principle; and that the thing described and claimed in Prof. Bell's specification was distinguishable, and that, even though their lordships held the Glasgow receiver was public, there was something so far an improvement upon it, that Prof. Bell's patent ought to stand.

The learned counsel quoted extensively from the evidence to prove his contentions.

The court adjourned.

Our continued report of the proceedings of this case, which was again before the court yesterday, will appear in our next issue.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

The Electric Light.

IN the year 1853, Mr. Joseph J. W. Watson, Ph.D., F.G.S., &c., published a small pamphlet, "On the present state and prospects of Electrical Illumination." The following extracts from Mr. Watson's paper may not be without interest to some of your readers:—

"The difficulty of carrying into the wide, and it may be said, rough field of practice, an invention such as electrical illumination, can only be really understood by those who have experienced it. A new field of labour has to be opened, and experience and education can be the only guide of those who may engage in it. Yet the requirements are not more strange than those which have been before felt. When Watt, and more recently, Stephenson, originated a system of travelling by the agency of steam, hands had to be obtained and trained to the management of the new force. In the same manner gas, upon which millions have been expended, is still but in the infancy of its manufacture. Electrical illumination, then, consists not in the mere arrangements of certain galvanic pairs, it requires something more; system, order, and economy must rule it, as with railways and steam navigation. The successful and permanent institution of telegraphic communication by the same mysterious force, offers the greatest possible inducement for its being taken up in the spirit that it deserves. The laying of the electrical mains, and the arrangement of a system of governors for regulating and measuring the quantity of electricity passing to the different lamps, is as much a matter of engineering as the arrangements of gas and water.

"Although it may be deemed, perhaps, superfluous to offer any remarks on the character and value of the electric light, we are yet willing to record here our own knowledge and experience of it. The electric light has no characters in common with other artificial sources of illumination. Its brilliancy, as obtained from carbon points, approaches, if not quite resembles, the light of day: its shadows, for depth, are equal to those of the most brilliant sunlight; and its diffuseness equals for effect that of the glorious orb itself; colours which, by all ordinary light, change as by a chameleon property, their hues are seen by it in all their purity of tint as in the broad light of noon. At sea, when the atmosphere is serene, it can be seen as far as the earth's convexity will allow the visual plane to extend. A point of one-tenth of an inch radiating the light seems at one mile distant as a globe of fire a foot in diameter. Seen through a large polyzonal lens, it has been perceived in all the brilliancy of its ordinary unassisted state at a distance of 30 miles from the place of exhibition. It requires no air to support it, and burns as well under water as it does in vacuo.

"In regard to the practical applications of which the electric light is susceptible, they must be too evident to require mention. For lighthouse purposes it is invaluable, and none but vested interests in other modes of illumination can ever possibly interfere with its adoption for this use. For signalling ships at sea, ships in convoy, lights of all kinds for vessels; for railway purposes, lighting tunnels, mines; and last, though not least, among its useful applications, diving bells; it has properties and advantages which no other description of light can command. In streets, it must with time and public favour entirely supersede the use of gas; and for lighting public assembly-rooms, theatres, and spectacles of all kinds, its successful achievements has only to be made known to insure its immediate adoption."

How apposite are some of the remarks of this inventor of thirty years ago, to this present time. As I have already taken up too much of your valuable space, I close by adding that Mr. Watson's patents were worked by the Metropolitan Electric Light Company, Wandsworth.

Fareham.

Electrical Accumulators.

From the editorial remarks appended to my letter of last week some of your readers may infer that the calculation there made regarding the E. M. F. available at the terminals of the glow lamps is erroneous.

In attempting to correct this possible impression, let me recall the statement under criticism. The rule given by the Electrical Power Storage Company to determine the proper number of cells required to form an accumulator runs as follows: "When the E. M. F. required to overcome the resistance of a lamp is known, it must be divided by 2·15, and the product shows the requisite number of cells to illuminate the lamps." In a table which follows it is stated

that for lamps requiring 45 volts an accumulator of 22 cells is requisite, and that this accumulator may be discharged with a current of 30—40 ampères.

That the rule given is absurd and misleading becomes evident from the following consideration. Although the *total* E. M. F. of an accumulator may be independent of the external resistance, it is not so with the E. M. F. available for external work, and if the external resistance is diminished, say by putting on a number of Swan lamps in parallel circuit, the E. M. F. at the terminals of the accumulator will fall considerably. In the example taken last week it was found that on discharging with a current of less than 32 ampères (it would be worse with 40), the E. M. F. at the terminals of an accumulator recommended for Swan lamps, requiring 45 volts, actually fell to 38·7 volts, proving that a 22-cell accumulator is not sufficient by *5 cells* to light the lamps for which it is specified even when employing almost the minimum discharge.

The calculation is surely easy enough to follow. Let E = E. M. F. of each cell; r = its resistance; n = the number of cells in the accumulator; R = the external resistance, and e = E. M. F. at terminals of accumulator, then

$$\mathrm{E}\,n : e :: n\,r + \mathrm{R} : \mathrm{R}$$

and

$$e = \frac{\mathrm{E}\,n \times \mathrm{R}}{n\,r + \mathrm{R}}$$

while

$$n = \frac{e\,\mathrm{R}}{\mathrm{E\,R} - e\,r}.$$

Substituting numerical values for these letters we have E = 2·15; r = ·0125; n = 22 and R = resistance of 28 Swan lamps of 35 ohms each = 1·25 ohm,

$$e \text{ becomes} = \frac{2{\cdot}15 \times 22 \times 1{\cdot}25}{(\cdot0125 \times 22) + 1{\cdot}25} = 38{\cdot}7 \text{ volts.}$$

But for properly lighting Swan lamps we require e = 45, substituting for e, 45,

$$n \text{ becomes} = \frac{45 \times 1{\cdot}25}{(2{\cdot}15 \times 1{\cdot}25) - (45 \times \cdot0125)} = 27 \text{ cells.}$$

Consequently, instead of the 22 cells given in the table, 27 would be required, and the cost to the purchaser would be £135 instead of £110. But when we endeavour to find the rule by which these cells have been classified as one, two, and five horse-power each, we are simply amazed. The one horse-power cell discharges with a maximum current (see table) of 40 ampères. Its E. M. F. is 2·15 volts, consequently work is given out at the rate of 86 watts = ·115 of a horse-power, or something over one-tenth of what it is represented to do. To say that a cell is one, two, or five horse-power conveys no idea whatever of the amount of energy it has stored. Horse-power is a *rate* and not a *quantity*. The energy ought to be specified in horse-power hours with the maximum rate of yielding work given. To say that this circular displays a want of knowledge is to employ very mild criticism indeed.

E.

[We have received a letter from the Electrical Power Storage Company which arrived too late for insertion in the present number. We shall, however, publish it in our next. The letter points out that the resistance of each accumulator is ·003, and not ·0125 ohms; this considerably modifies "E's" calculations—in fact, it quite justifies the company's rule.—EDS. ELEC. REV.]

The Electric Lighting Act—Provisional Orders.

Since you have so courteously opened your columns to the discussion and criticism upon the subject referred to, permit a practical man to avail himself of the permission for offering a few remarks on a special point—namely, on the unit adopted for the measurement of energy supplied.

The *Schedule C* is as follows:—"The term 'unit' as used in this schedule shall be deemed to mean the energy contained in a current of 1,000 ampères flowing under an electromotive force of one volt during one hour."

The term and definition of the so-called *unit* are both objectionable. What the consumer will pay for is a definite quantity of energy furnished to him by the undertakers. I can perfectly understand the meaning of a foot-pound, a Watt, a meg-erg, a kilogrammètre, or the work of one horse-power during an hour, all these quantities or their suitable multiples expressing a definite amount of energy. I don't know what is a *unit* of energy, and some confusion will often occur if this term is accepted in practice. But the definition, looking but very simple, is yet worse than the term itself.

The quantity of energy called the unit is a definite quantity, *perfectly independent of the time*, and which will be paid for by the consumer, say, each month or each quarter, whatever may have been the *rate* of consumption and the *duration* of this consumption each day.

Under these conditions, where is the necessity of introducing so *complicated* a unit, in which is introduced the time (1,000 ampères flowing during one hour)?

Adopting, as has been done, the ampère, the volt, and the ohm, as electrical units, the only logical units in this case are the erg, the meg-erg, or the volt-ampère (*alias* watt). As the erg is too small a unit of energy in practice, we can take the *erg-ten*, the *watt-ten*, and so on.

I give here a table of reduction of the so-called "unit" in Schedule C, in the various units of energy now adopted and employed by scientific and practical men. A glance at it will suffice to convince the reader that simplicity is not the characteristic of the new "unit."

1,000 ampères during one hour gives—

1,000 × 3,600 = 3,600,000 coulombs.

The work done by this quantity of electricity under an electromotive force of one volt is—

3,600,000 Watts (or volt-ampères).
36,000,000 meg-ergs.
368,000 kilogrammètres.
2,660,000 foot-pounds.

When we express the "unit" in horse-power, we find by a simple but tiresome calculation that the "unit" corresponds to one horse-power during *one hour and twenty minutes*.

I shall be pleased to know by what method of reasoning Mr. Fletcher Moulton has arrived at this complicated and miscalled "unit."

Simplex.

[Our correspondent has evidently obtained for himself a copy of the "Provisional Orders." We have not yet arrived—in the course of our remarks upon Mr. Moulton's elaborate production—at Schedule C, but in due course we also shall have something to say on the "unit" proposed for adoption.—EDS. ELEC. REV.]

Dynamo-Electric Machines.

I am perfectly well aware that in the case of a water resistance there is a back E. M. F. to be taken into account, and this is precisely the reason why the volts, as well as the ampères, were measured. Under these circumstances the results are far more accurate than would be the case if a wire of a certain resistance were made to carry the current and its resistance assumed to remain constant; moreover, a wire resistance, even of only half an ohm for a current of 200 ampères, is a very difficult and costly thing to arrange.

I find a solution of sulphate of sodium more pleasant than sulphuric acid in use, as the fumes are not so irritating.

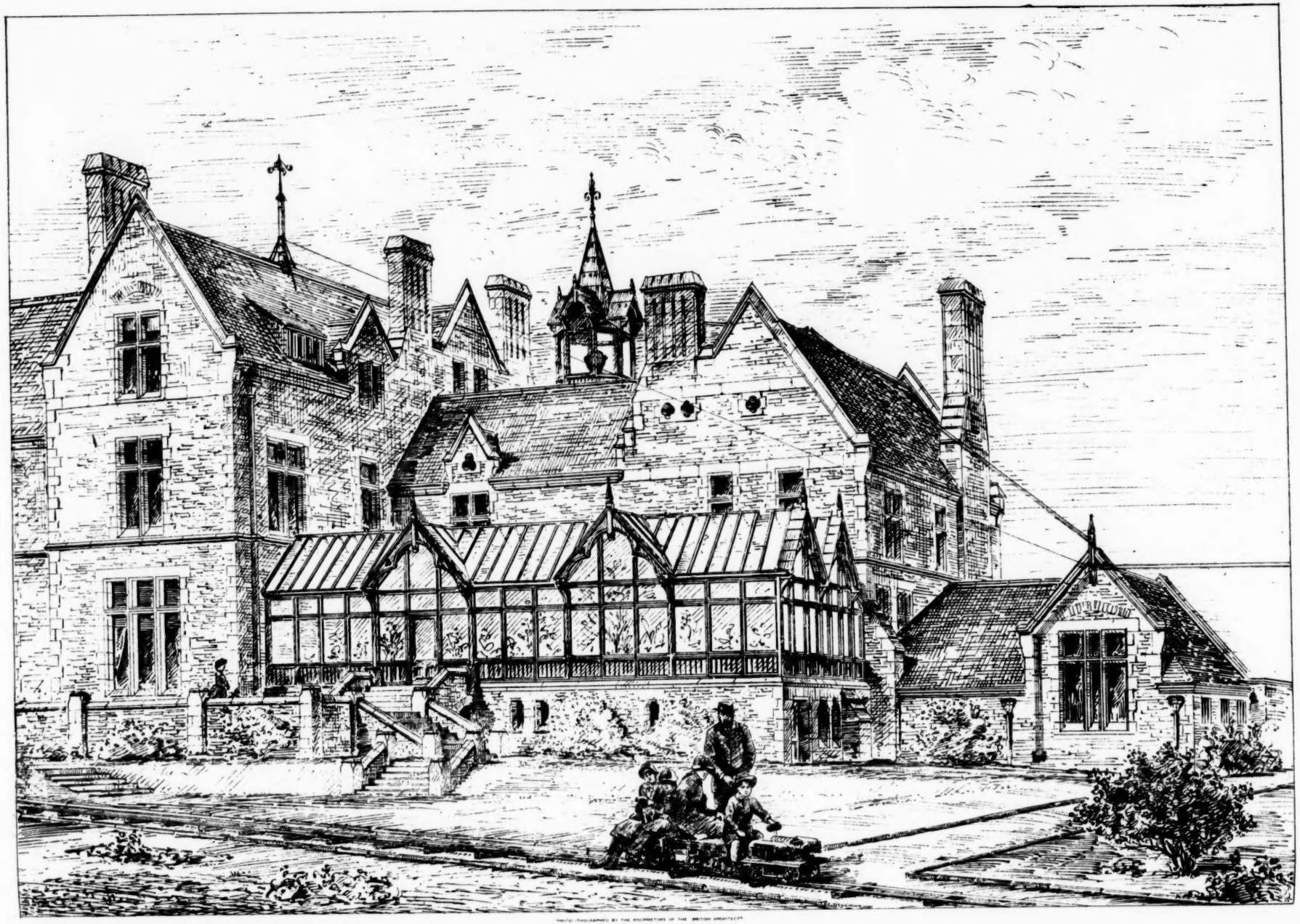
Fras. J. Mudford.

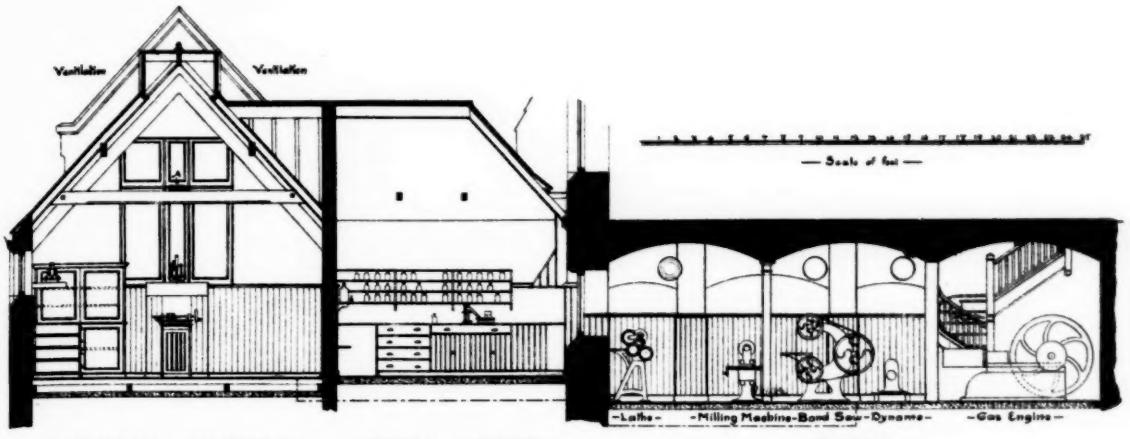
77, Mildmay Grove, N.,
January 27th, 1883.

[Mr. Mudford will find in our other columns a short article on the subject to which his letter refers. It would not be necessary to assume anything in regard to a wire resistance; whatever it was, the reading (if correct) of the volt and ampère-meters would enable us to calculate it. Would not a solution of sulphate of zinc with zinc plate electrodes be still better?—EDS. ELEC. REV.]

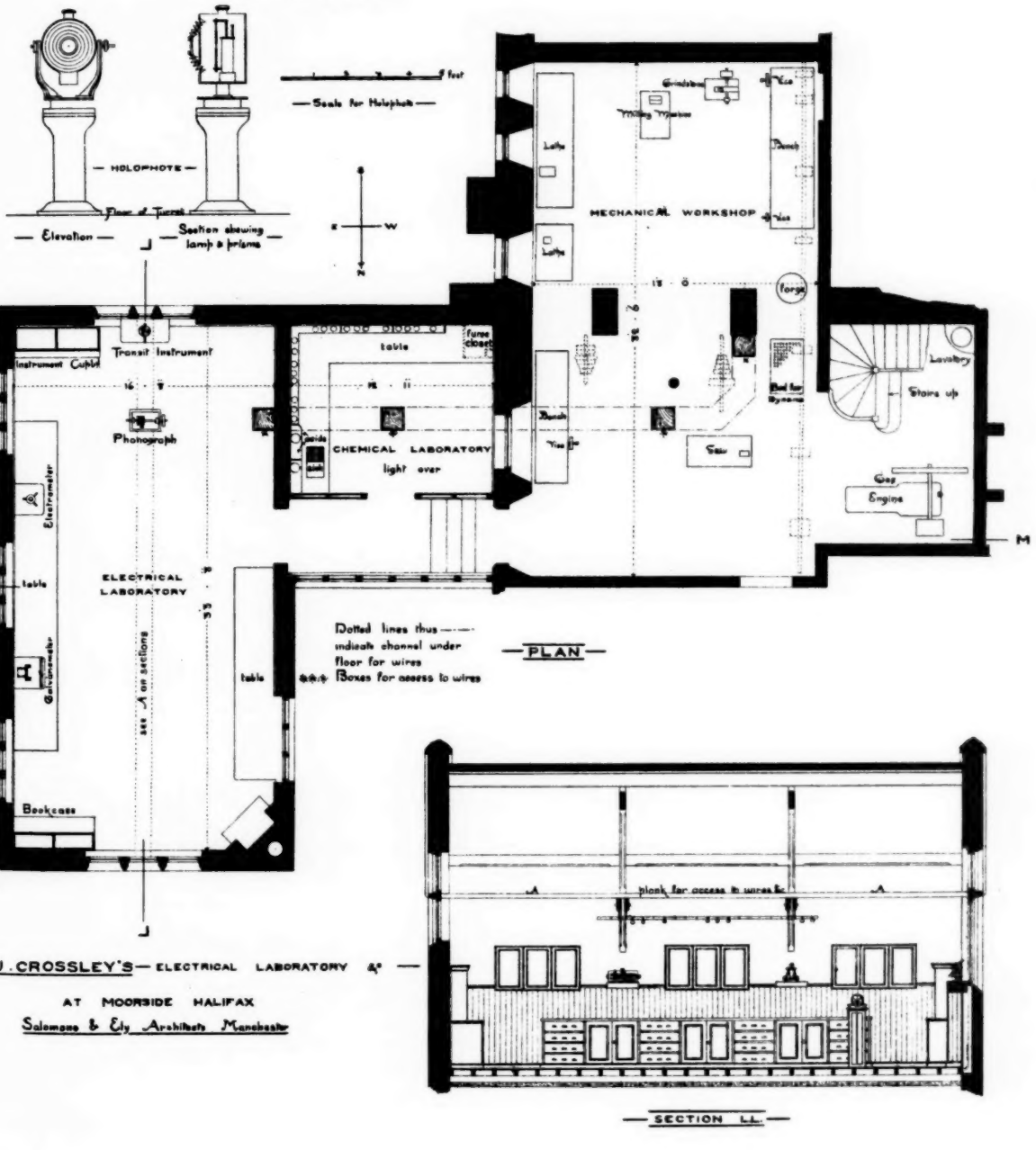
Electric Light Fittings.

With your permission, I would venture to call attention to the different fitting for incandescent lamp sockets now in use. There are, I believe, no less than three different sockets for Swan lamps, one having 7-16″ female fitting, one 3-8″ male fitting, and one with the so-called "burner" size, 5-16″ taper thread. The Lane-Fox have two sockets, one with 7-16″ and one 3-8″ female fitting. The Duplex use 5-16″ taper thread, and Maxim uses 3-8″ female for his sockets; all sockets for Edison lamps have hitherto had




Ventilator
Ventilator
— Scale of feet —
-Lathe- -Milling Machine- Band Saw- Dynamo- -Gas Engine-
— ELECTRICAL LABORATORY — — CHEMICAL LABORATORY — — WORKSHOP —

— SECTION M.M. —



— SECTION L.L. —

— Mr L. J. CROSSLEY'S — ELECTRICAL LABORATORY &c —

AT MOORSIDE HALIFAX

Salomons & Ely Architects Manchester

PHOTOLITHOGRAPHED BY THE PROPRIETORS OF THE BRITISH ARCHITECT

3-8″ female fitting. I would suggest, that some universal size be adopted by all the companies for their sockets. This would make the various systems, so far as the lamps and sockets are concerned, interchangeable, and would be of great convenience, not only to individuals but to manufacturers at large.

I think attention to such details as these would go far to take away the opinion, at present far too prevalent, that electric lighting needs much simplifying before coming into general use.

J. B. V.

January 28th, 1883.

[We think our correspondent's suggestion well worthy of consideration.—EDS. ELEC. REV.]

The Society of Telegraph Engineers and of Electricians.

The inference drawn by Mr. Frost from my letter, although admissible, is not exactly the one I had intended should be drawn. While improvements are being introduced year by year, was it unreasonable to expect that the removal of books from the library for the benefit of provincial members should be amongst the number, and that when it was not, that disappointment should be felt?

But no desire on the part of provincial members to enjoy the aforesaid benefit has been shown. And why so? Because by the rules of the society books may not be removed from the library. Is it not, therefore, too much to expect that provincial members shall ask the librarian for what according to the rules of the society he cannot give?

That Mr. Frost is at all times ready to receive suggestions is well known, and I would respectfully ask him to consider the one put forward by

Your obedient servant,

Fareham.

Corrections.

In your edition of January 20th you say that the extensive goods yards at Nine Elms station are lighted by means of the Edison light. Permit me to correct this statement. The goods yard is lighted by Crompton arc lamps. The whole of the plant, consisting of two 16-horse-power compound engines, five Crompton-Bürgin dynamos, the necessary countershafting, 17 lattice poles 50 feet high, each carrying two lamps, and the 28 lamps, with leads, switches, and connections, were supplied by R. E. Crompton & Co. The plans for the installation were prepared by this firm, and the erection of machinery and lamps was done partly by this firm and partly by the South-Western Railway Company.

Gisbert Kapp,

Manager to R. E. Crompton and Co.,

January 26th, 1883. Arc Works, Chelmsford.

[We are pleased to insert Mr. Kapp's correction of our inadvertent statement.—EDS. ELEC. REV.]

I shall be glad if you will correct a paragraph in your paper of last Saturday in which you state that "It is contemplated to adopt the Edison system in the Prince's theatre during the year." I have the authority of the engineer of the theatre to say that this is not correct, as at present they have not definitely settled whose lamp to use, but the Swan is most likely, if suitable terms can be made. Apologising for taking up your valuable space.

H. Bury.

46, Market Street, Manchester,
January 29th, 1883.

Note on a Simple Form of Lipmann's Capillary Electrometer.—At the recent meeting of the Glasgow Philosophical Society, Dr. McKendrick read a "Note on a Simple Form of Lipmann's Capillary Electrometer." This instrument consists of a fine capillary tube containing mercury and dilute sulphuric acid, so placed under a microscope as to show a junction of the metal with the acid. A fine platinum wire dips into mercury at each end of the tube, and so extremely sensitive is it that feeble currents obtained from muscle and other sources at once cause a movement of the mercurial column. Specimens of the instrument were shown, and its sensitiveness demonstrated by various experiments.

NOTES.

Electric Lighting.—From America comes the report that about three weeks ago the wires of the Baxter Electric Light Company were crossed by the wires of the New Jersey Telephone and Telegraph Company in Jersey City, and part of the city thrown into darkness for several hours. The diverting of the powerful current from the Baxter wires to the telephone system destroyed several instruments. The Baxter Light Company say that the crossing was the result of malicious mischief, the wires being found tied together with an old woollen scarf. Experts say that the fault was caused by the sagging of the Baxter wires, as the insulator is burned off in several places. There have been two fires in Chestnut Street, Philadelphia, since the electric light wires were erected there. In both cases the firemen were greatly impeded in their efforts to get ladders up to the burning places by the electric conductors overhead.

Reports from Montreal show that at the recent ice carnival the electric light played no insignificant part in the magnificent pageant.

The extensive premises of the "Merchants' Alliance," near St. James's Church, Bath, are to be lighted by electricity on the 14th inst., the necessary arrangements having been made with the Great Western Electric Light and Power Company (Brush system).

The petition for the winding-up of the Yorkshire Brush Electric Light Company was called before Vice-Chancellor Bacon, in the Chancery Division of the High Court of Justice, on Saturday last, when Mr. Warrington, Q.C., intimated that it had been arranged that the petition should be dismissed without costs. This was accordingly done.

The foreign settlement at Shanghai has for some time been lighted on the Brush system, but the Chinese governor of the district has addressed a letter to the senior Foreign Consul, requesting the removal of all the electric lamps. He has read, he says, in translations from European papers, that terrible accidents have arisen from electricity. He has therefore strictly forbidden his own countrymen to use it, and has peremptorily ordered those who have already adopted it to discontinue it forthwith.

The Metropolitan Board of Works last week adopted the following resolution: "That it be referred to the committee to prepare and deliver to the Board of Trade objections to the various Provisional Orders applied for under the Electric Lighting Act, 1882, with such clauses as may secure the Board's right over the Thames Embankments, the bridges, subways, and the sewers of the metropolis."

At a meeting of the Marylebone Vestry, held last week, the Parliamentary Committee reported that, having considered the various notices given for Provisional Orders for providing electric lighting in certain parts of the parish they recommend that, as electric lighting is now almost in its infancy any arrangement with an electric company should be only tentative, and that the Provisional Orders should be opposed, but asked leave to negotiate with companies for supplying electricity for a limited period under licence in a selected portion of the parish. The report and recommendation were unanimously adopted.

At a recent meeting of the New England Cotton Manufacturers' Association considerable attention was given to electricity as a lighting agent for textile mills; several manufacturers and others commending it. Mr. Atkinson, president of the Boston Manufacturers' Fire Insurance Company, held that the incandescent lamp is the true factory light of the future, the safest light that can be put into a mill, the best light as regards quality of work done, and the health of operatives. The numerous fires in electric plant in mills under the company's supervision had been relatively safe fires, easily put out, and there had been none from the incandescent light. The fewer fires from gas had entailed very heavy losses. Mr. Woodbury, agent for the Boston Underwriters, who has had extensive opportunities of observing the application and use of the electric light, considers that electricity forms the safest method of illumination where certain precautions are taken. *Inter alia*, the importance of regular tests to detect any escapes is urged very strongly.

It is reported that the Edison Electric Light Company proposes to make Toronto the headquarters of its Canadian branch.

The Bermondsey Vestry last week "approved of the grounds of opposition to the objections, and to the amended clauses to the draft provisional order of the Metropolitan (Brush) Electric Light and Power Company (Limited), authorising the company to erect and maintain electric lines and works, and to supply electricity within the parish and the hamlet of Penge, in the county of Kent."

At a meeting of the Wandsworth Board of Works last week a report was received from the sub-committee with reference to the draft clauses proposed to be inserted in the Provisional Order, applied for by the Metropolitan (Brush) Electric Light and Power Company, for the supply of electricity in the district. The original proposal of the company was to light merely the main roads in the district. The board objected to this, and the sub-committee now suggested that the company should be allowed to select one parish, and be compelled to light any portion of it that the board might request. After some discussion, the matter was referred back to the sub-committee to secure the insertion of clauses that would carry out their suggestion.

The Newington Vestry, at a meeting last week adopted, by 26 to 11, a report of the Works and Sanitary Committee, recommending that a draft licence submitted with the report defining the "area of compulsory supply" in accordance with the provision of the Electric Lighting Act, 1882, be approved; that a memorial asking for the approval of the Board of Trade thereto be sealed, and that a cheque be drawn in favour of the board for £50, to be deposited with the memorial in accordance with the rules issued by the board.

The Vestry of St. Martin's-in-the-Fields has decided to oppose the granting of Provisional Orders by the Board of Trade, chiefly on the general ground that the applying companies seek to set aside the provisions of the Electric Lighting Act of 1882, and the rules of the Board of Trade in relation thereto, and to extinguish the right to control the public streets now vested in the local authority. A letter intimating this decision has been addressed to the Board of Trade by the clerk to the company.

A special meeting of the Kensington Vestry was held in the council chamber at the Town-hall on Monday night, to receive a report of the Works Committee with respect to the applications of two companies to supply electricity to the parish. The meeting was necessary in order to submit objections to the Provisional Orders to the Board of Trade on the 1st of February. The committee suggested a number of objections, and the report was unanimously adopted.

We hear that Mr. Johnson, from Mr. Edison's factory, is about to return to this country for the purpose of taking in hand the general management of the Edison Electric Light Company. Also it is rumoured that Mr. Hammer will at an early date re-assume the position of electrician.

International Telegraph Conference.—We notice the following in the *Journal Télégraphique de Berne*, of the 25th ult. In consequence of the decision of the Portuguese Government to convoke for the 1st of October of next year the Postal Congress which was to have taken place in Lisbon this year, the German administration on their part have decided to put off until 1885 the International Telegraph Conference, their meeting at Berlin having been fixed for the same year, 1884, in the belief that the Postal Congress was to have taken place in 1883. As the services of Posts and Telegraphs form now in most countries part of the same administration, and are consequently placed under the superior authority of one and the same chief, the exigencies of the service of the administrations, and the professional obligations of the officials nominated to represent them at those meetings, render it very difficult if not impossible for the Postal Congress and the Telegraph Conference to hold their international sessions at the same time, or even at dates following each other too closely. The adjournment of the Telegraph Conference to 1885 will enable the different administrations, by submitting the system of taxation introduced in London to a longer practical trial, to appreciate with a more thorough knowledge of the matter the improvements and modifications which it may be found requisite to finally adopt in all tariff rules, in so much as regards telegraph communications.

Telegraphs in Siam.—We notice that several French telegraphists have left Marseilles in the *Irrawaddy* for Bangkok, where the king of Siam intends to establish a telegraph station. This appears to be rather late in the day, as a station has been in existence there for some years. The present arrangement might, without doubt, be much improved, as the gentleman lately in charge is a Siamese noble (one of the king's numerous cousins), and displays a princely disregard for European business ways.

The Telephone.—It is said that at the request of His Excellency the Commander-in-Chief, instructions have been given to establish, before next session, telephonic communication between Sir Frederick Roberts' usual residence, "Snowdon," at Ootacamund, and the offices of the Headquarters, and any other Government department he may consider necessary; the necessary "exchange" station being the Government Post-office.

For some time the idea has been prevalent in Aberdeen that the charge of £15 per annum for each subscriber to the National Telephone Company's Exchange is excessive. Efforts are now being made to form a local company to provide telephonic intercommunication at the rates of the Dundee and District Telephone Company, viz., £5, or £5 10s. a year. On Tuesday week last, a public meeting of traders and others interested in the question was held, and resulted in the appointment of a committee to collect the necessary information for the carrying out of the scheme.

The Telephone in the United States.—Lowell, a town in the United States, situated in Massachusetts, at about forty kilometres from Boston, and which, because of its numerous cotton mills, has been surnamed the "Manchester of the Union," may be mentioned as an example of the rapid development of the telephone in North America. At the end of 1877, says *La Lumière Electrique*, the Telephone Company of Lowell had only sixty subscribers. On the 1st October, 1880, there were six hundred, whilst at the present time the number amounts to nine hundred. Each month the company erects about twenty new telephones; and Lowell now possesses one telephone for every sixty-two inhabitants. In another town of the Union, in Portland, Maine, there are about seven hundred telephones, and the proportion is one telephone for every fifty inhabitants. But when we take into consideration that there are in Lowell twenty thousand people working in factories, the great number of telephones employed in that town appears to be more remarkable still. Lowell and Portland are connected by telephone and conversation between those two places is kept up in a very clear manner. The distance is about 115 miles.

Illumination of Internal Cavities by Means of the Electric Light.—At the last meeting of the Northumberland and Durham Medical Society, I exhibited Mr. Payne's improved electric light appliances, and showed how some of them might be employed for microscopical and clinical purposes. For the past few months I have been engaged with Mr. Payne in suggesting adaptations of these instruments to the purposes just alluded to. Remembering that Sir Henry Thompson, more than a year ago, explored the bladder by means of the electric light, and that Leitz, of Vienna, is devising instruments for illuminating the throat, posterior nares, bladder, uterus, &c., Mr. Payne made an instrument by means of which the throat could be examined. Having at the present time a patient in the infirmary who is suffering from hydatid disease of the liver, and on whom the operation of abdominal section with incision of the liver had been performed, took advantage of the opportunity and succeeded in lighting up the interior of the cyst by means of the electric light. For this purpose Mr. Payne devised and constructed a brass tube, electro-plated, nine and a half inches in length, and eleven-sixteenths of an inch in diameter

externally. One end of this tube was funnel-shaped, and the other was closed by a piece of glass; down this tube was inserted a narrow cylinder, which carried a Swan's lamp and the electric wires. This tube, with its glazed extremity, was smeared with carbolised oil (although in future I shall use carbolised glycerine for the window of the tube), and with gentle pressure I succeeded in passing it through the abdominal incision into the interior of the liver. The lamp was at once lit, and I had the pleasure of observing a grayish red condition of the wall of the cyst, studded across which were numerous yellow-white spots, evidently pus; a slight oozing, or sweating, was also noticed on the wall of the cavity. The illumination of the interior of the liver by means of the electric light was in every way satisfactory and successful, and although it is of little aid in the treatment of the case in question it has shown us that the lighting up of the internal cavities is not only a possibility, but a matter of comparative ease. With the extremely small size of the Swan's lamp required (it is not much larger than an ordinary bean), and which gives a light equivalent to that from three candles, and with the improved instruments which Mr. Payne is devising, I see how the electric light might become useful in operations for vesico-vaginal, or recto-vaginal, fistula, and in certain diseases of the bladder. Before making use of this illuminating endoscope on the human subject I tried its effects in a dark chamber; I read with ease a piece of print placed therein.

MR. PAYNE'S REPORT.—Leiber's arrangement contains an electric lamp in which platinum wire is heated by means of battery power and rendered incandescent. The arrangement I made is of much simpler construction, gives a perfectly pure light, and develops less heat. It consists of an electro-plated outer tube, nine inches and a half long by eleven-sixteenths of an inch external diameter, glazed at one end with a stout piece of plate-glass made perfectly secure and tight.

A Swan's electric lamp is used, the filament of which is carbon and rendered incandescent by means of battery power. It is hermetically sealed in a glass shade, and water conveyed to and fro through very small brass tubes, is made to circulate round the lamp. The light from this lamp is perfectly pure, and exhibits the conditions of things in their true and natural colour. For prolonged observation, I should prefer to use either a Grove's or Bunsen's battery, but in the demonstration just referred to, four cells of a modified Leclanché battery were employed, and answered admirably. It is advisable to have as great a pressure as possible for the water supply, so as to insure perfect circulation, and for this I suspended from a hook fixed near the ceiling of the room a tin can containing water, connecting it with the brass tubes by means of lengths of india-rubber tubing.—Thomas Oliver, M.D., M.R.C.P., Physician to the Infirmary, Newcastle-upon-Tyne, and J. B. Payne, F.R.M.S., Newcastle-upon-Tyne.—(*From the British Medical Journal.*)

The Giant Causeway Electric Tramway.—Major-General Hutchinson, on behalf of the Board of Trade, has made an official inspection of the Giant Causeway, Portrush, and Bushmill electric tramway, and expressed himself as highly pleased with his inspection. The formal opening of the line will take place in the spring, under the auspices of the Lord Lieutenant of Ireland, who has intimated his intention of personally performing the ceremony.

New Model of Callaud's Sulphate of Copper Battery.—In *L'Electricien* of the 15th ult., we notice the following description of this battery:—

"Callaud's Sulphate of Copper Battery (Dumoulin-Froment Model).—In this battery, made by Messrs. Dumoulin and Froment, the sulphate of copper is placed in a glass jar, in the bottom of which there are two holes. By this arrangement the sulphate of copper can easily be removed, and the liquid be more or less stirred up, without bringing the solution in immediate contact with the zinc. The piercing of the two holes can be easily done, and at very little cost.

"The positive pole is formed by a copper wire, rolled in the shape of a spiral at its lower end, and consequently is without weld, solder, or any possible break in its continuity. A protection of rubber, sufficiently thick, formed by a simple tube slipped over the end of the copper wire, covers it from the bottom to outside the outer jar. The zinc is suspended by two hooks, which are simply passed through two holes made in the top of the jar, and which rest on the edge of the outer jar.

"This battery has one peculiarity which can be of a certain use as regards attending to it—namely, the difference generally noticed between the level of the liquid inside and outside of the glass jar. If the battery is in good condition, the liquid in the jar is lower than that with the zinc, thus showing that the solution of sulphate of copper is concentrated, or nearly so, and that of zinc sulphate is not so; this case proves the battery to be in good working condition. If, on the contrary, the heights of the liquids are equal, or even if the sulphate of copper should be higher than the other, it is because the copper solution is not concentrated enough, or that the sulphate of zinc solution is overcharged with salt.

"The constants of the battery thus made do not differ at all from those of the ordinary callaud (E = about 1 volt, R = 6 to 8 ohms), because the positive pole is always kept in the solution of sulphate of copper, which escapes from the jar through the two holes.

Special Oil for Gas-engines.—We understand that Mr. J. R. Rhodes, of Barton Arcade, Manchester, has for a long time past devoted persevering and constant attention to this subject, and that he has at length been rewarded by producing an oil peculiarly well adapted for use with all kinds of gas-engines.

Society of Telegraph Engineers and of Electricians.—The next meeting of the society will be held at 25, Great George Street, on Thursday, February 8th, at 8 p.m., when the following papers will be read: "On the Magnetic Storm of November 17th, 1882," by James Graves, member (communicated by H. Weaver, member); "On a Magnetic Storm in India," by E. O. Walker, member; "On Earth Currents in India," by E. O. Walker, member: "Earth Currents (third paper), Sun Spots, and Electric Storms," by Alex. J. S. Adams, associate. We understand that Professor D. E. Hughes will shortly bring his recent researches into the nature of magnetism before this society.

Electricity v. Hangings.—The *British Medical Journal*, examining the proposal of Mr. Lane-Fox to employ a Microfarad condenser for the destruction of worn-out horses and domestic animals, says:—"We believe that, should murder by electricity ever be practised, the resources of medicine and science will prove equal to the detection of the agent employed. The accidents that may be expected to result from the extension of electric lighting will doubtless soon afford medical men the opportunities of becoming more familiar with the appearances resulting from death from electricity. Mr. Lane-Fox's proposal is a humane one, but we question whether it will meet with serious recognition. It is applicable to horses and pet animals only, and is inapplicable to animals the flesh of which is to be used for food. Death is asserted to be painless. Probably it is so; but of this we know and can know nothing. The feasibility and advisability of judicial executions being carried out by means of electricity is one which is well worthy of consideration; and certainly, now that executions take place in private, and the criminal at the moment when the drop falls becomes immediately removed from the view of all but the executioner, there are additional reasons why the existing mode of carrying out the dread capital sentence of the law in Britain should be revised. It is well worth consideration whether the use of electricity or the simpler mode of strangulation recently proposed by Dr. Hammond, of New York, should not be substituted for the present system. Dr. Hammond's method has the advantage over the electrical that we have the personal voucher of a man of his high reputation that the sensations of the strangled man, up to the moment when unconsciousness supervenes, are rather pleasurable than painful!!"

New Telegraphic Offices.—The Direct United States Cable Company and La Compagnie Française du Télégraphe de Paris à New York have now opened an inde-

pendent office at No. 40, Broadway, New York, for the receipt and delivery of messages transmitted by their respective cables. This independent office is placed in direct communication with the cables of the Direct and French Companies by special wires worked by the companies' own staff.

Prize Electrical Essay.—A prize of £100 for the best essay on the utilisation of electricity for motive-power is offered by the Society of Arts. Preference is to be given to that essay which, besides setting forth the theory of the subject, contains records with detailed results of actual working or experiment. The society reserves the right of publishing the essay.

Verity v. The J. B. Rogers Company.—In the Lord Mayor's Court, held at Guildhall on Tuesday, before the Assistant-Judge (Mr. Woodthorpe Brandon), Messrs. Verity Brothers, of Regent Street, proceeded against Messrs. The J. B. Rogers Company, electricians, of Holborn Viaduct, to recover £22 8s. the price of certain pendants fitted for the electric light, alleged to have been supplied the defendants in accordance with order. Mr. Mackaskie appeared for the plaintiffs and Mr. Glyn for the defendants. The action arose out of the Furniture Exhibition which was held at the Agricultural Hall, Islington, last year, and at which both plaintiffs and defendants were exhibitors—the former of furniture, the latter of their system of electric lighting. Originally an agreement was entered into between the parties for defendants to light a dining and drawing-room, and library, and promenade—the plaintiffs to provide pendants of a selected design—at a cost not exceeding £100. But the designed pendants were not ready in time, and eventually the defendants provided their own standards. The plantiffs, however, did not consider them sufficiently embellished, and improved them by adding certain scrolls and leaf work, for the execution of which they now claimed £22 8s. The defence was that the work was done at their own request, and that they participated in the advertisement arising therefrom. Further, defendants expressed their willingness to return the work if the plaintiffs would restore the standards to their original condition. After hearing evidence on both sides the jury found for the defendants.

Gardner v. Maxim-Weston Electric Light Company.—At the Lord Mayor's Court on Tuesday, Mr. James Gardner, a clerk, formerly in the employ of the Maxim-Weston Electric Light Company, brought an action for £50, wages said to be due for overtime work performed by him for the company. The defence was that the overtime was never performed or ordered. Mr. Glyn appeared for the plaintiff, and Mr. Jones for the defendants. The plaintiff stated that he was employed as transfer clerk to the defendant company, first at a salary of £80 a year, which was afterwards increased to £100; that the office was altogether underofficered, and that as a consequence his work fell into arrear, necessitating his going early to the office and staying late at night. The secretary often admitted that he was doing extra work, and promised him compensation. Changes took place in the management, and when Mr. Watt, a new managing director, came he at once set about cutting down expenses. He was overbearing in his manner, and once when witness was warming his hands at the fire he called him an insolent cur, an insolent ruffian, and a d——d blackguard. After having such language used to him, he (witness) threatened to punch his head. Two fellow-clerks of the plaintiff (both of whom have since left the employ of the defendants) corroborated as to his working overtime. The Judge, in addressing the jury, said it appeared to him that Mr. Watt did not behave as a manager ought to do and as gentlemanly masters did to their clerks. It was perfectly clear he was a new broom, and went into the office with the determination to cut down all salaries. Plaintiff was the first man attacked, because he got as much as £100 per annum salary. Whatever language was used did not affect the rights of the parties. The question which the jury had to decide was whether the extra work was done, and on that point they had the evidence of the plaintiff and his fellow-clerks. After a short consultation, the jury gave a verdict for the plaintiff for £25.

The Postal Telegraph Engineering Department.—The consideration of the memorial presented by the mechanics and linemen of the Postal Telegraph Engineering Department has resulted in an improved scale of allowances and the award of good-conduct stripes to a large number of the men. These substantial benefits have given much satisfaction to the staff, who appreciate the efforts of their chief to ameliorate their condition.

Fire Alarms.—From a return of fires for 1882, presented at the last meeting of the Glasgow Town Council, it appears that the electric fire alarms placed throughout that city were during the year used 152 times to intimate the outbreak of fires. In 45 instances they were the means of calling out the brigade unnecessarily—15 of which alarms were given with good intent, 9 through contact with other wires, and 21 thoughtlessly or mischievously.

Thermodynamic Analogy of Thermo-electric Phenomena, and of Peltier's Phenomenon.—By E. Bautz.—If a closed circular channel, impermeable for heat is filled, half, A, C, B, with sand saturated with water and half, B, D, A, with air saturated with moisture, and heated at A, there arises a permanent circulation in the channel. The water at A evaporates, and condenses at B, whilst in the sand it passes from B to A, just as in a thermo-current. If, on the contrary, instead of heating A the water is set in motion by a rotatory pump from B through C to D, the water evaporates at A. A is refrigerated, and water condenses at B, which becomes heated quite in analogy to Peltier's phenomenon. Besides, friction occasions a liberation of heat in the entire circuit, in accordance with Joule's law.—*Wiedemann's Beiblätter.*

On the Terrestrial Induction of the Planets, and in Particular that of Jupiter.—By M. Quet.—The author undertakes to show by mathematical calculations that the induction forces produced in the electricities of the earth in virtue of the rotation of the planets and of the sun around their axes are, all other things being equal, inversely as the squares of their distances from the earth, and directly as the volumes of the inducing bodies, their angular velocities of rotation, and their magnetic powers.—*Comptes Rendus.*

NEW COMPANIES REGISTERED.

Telephone Company of Egypt (Limited).—Capital £100,000, in £5 shares. Registered office, 3, Great Winchester Street. Objects: To carry on in Egypt and its dependencies the business of a telephone company. Signatories (with one share each):—Col. G. E. Gouraud, Upper Norwood; W. G. Hall, 13, Telford Avenue, Streatham Hill; J. S. Cooke, C.E., Gray's Inn; R. S. Cuff (electrician), 5, Cedar Road, Tottenham; J. L. Ryles, 26, Tavistock Street, W.C.; H. Asch, 17, Tugeler Road, Clapham Junction; L. J. Maton, 21, Cannon Street. Directing qualification: 20 shares. The first directors are: Lt.-Gen. A. Fraser, C.B., Col. Gouraud, and Mr. James Pender. Remuneration: £150 per annum to the chairman and £100 per annum to each other director. Registered 30th ult., by John Mackrell & Co., 21, Cannon Street.

Electric-Motor Syndicate (Limited).—Capital £12,000, in £100 shares. Registered office, 3, Copthall Buildings, E.C. Objects: To acquire the letters patent of Desiré Thomas Piot, dated 5th November, 1881, No. 4851, for an improved electric-motor; also to acquire the letters patent of John MacDonald, dated 18th October, 1882, No. 4957, for improved road vehicles. Signatories (with one share each): J. MacDonald, C.E., 5, Southampton Buildings; A. Browne, 5, Southampton Buildings; J. Jones, 63, Grosvenor Road, N.; W. C. Cross, 4, Mona Road, Peckham; C. R. A. Derby, 418, Commercial Road, E.; J. H. Slater, 58, Haverstock Hill; A. C. Kendrick, 4, Richmond Road, Shepherd's Bush. Registered 30th ult., by Foster, Hight & Co., 3, Copthall Buildings.

NEW PATENTS—1883.

295. "Improvements in treating yarns for and in covering wires for telegraphic, telephonic, or electric lighting and other purposes, whether braided or lapped, and in spindles for the purpose, also applicable to spindles of braiding machines." W. T. GLOVER and G. F. JAMES. Dated January 18.

306. "Electric signs or apparatus for illuminating and signalling purposes." H. VAN DER WEYDE. Dated January 18.

308. "Electric signalling apparatus for use on railways." H. WALKER. (Communicated by C. D. Tisdale.) Dated January 18.

316. "Dynamo-electric machines." F. H. RELPH. (Communicated by J. Olmsted.) Dated January 19.

317. "Secondary or storage batteries." H. J. HADDAN. (Communicated by E. Boettcher.) Dated January 19.

321. "Switch for increasing or diminishing the strength of current in electric lighting apparatus." F. MORI. Dated January 19.

322. "Electric lamps." F. MORI. Dated January 19.

339. "Telephonic apparatus." J. GRAHAM. Dated January 20.

348. "Voltaic batteries." R. H. COURTENAY. Dated January 20.

349. "A telephonic apparatus." C. A. TESKE. Dated January 22.

357. "Dynamo or magneto-electric machines." H. H. LAKE. (Communicated by H. R. Bossier.) Dated January 22.

361. "Electric lamps or lighting apparatus." H. H. LAKE. (Communicated by H. R. Bossier.) Dated January 22.

371. "Electric lamps." A. E. SWONNIKOFF. Dated January 23.

397. "Means and apparatus for electric lighting." J. COOPER. Dated January 24.

400. "Electric generators and motors." W. M. MORDEY. Dated January 24.

405. "Insulators for telegraph posts or other supports." P. R. DE FANCHEUX D'HUMY. Dated January 25.

454. "Circuits and apparatus for electric temperature and pressure indicators." W. P. THOMPSON. (Communicated by R. Hewitt and C. L. Clarke.) Dated January 27.

460. "Telephones." T. J. HANDFORD. Dated January 27.

482. "Secondary battery or accumulator of electricity." A. L. NOLF. Dated January 29.

501. "Utilising electric lamps in dances, chiefly applicable to stage purposes." J. G. SANDERSON. Dated January 30.

508. "Primary voltaic batteries." G. G. ANDRÉ. Dated January 30.

520. "Electric lamps." A. KRYSZAT. Dated January 31.

526. "Apparatus for electrical communication on railway trains." R. W. VINING. Dated January 31.

535. "Electric-motors and dynamo-electric machines." S. PITT. (Communicated by F. B. Crocker, C. G. Curtis, and S. S. Wheeler.) *Complete.* Dated January 31.

539. "Tram, rail, and road cars and other vehicles and machinery for driving same by electricity." M. R. WARD. Dated January 31.

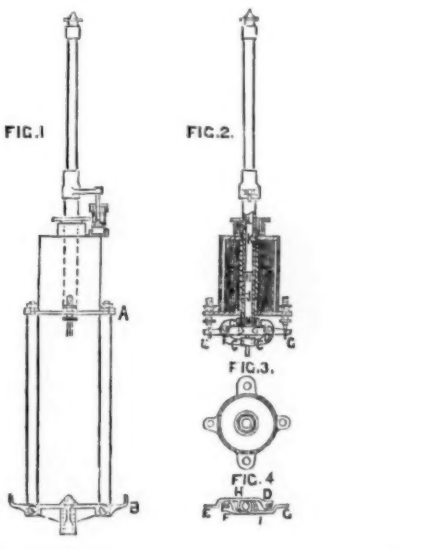
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

2518. "Compounds for electrical insulation, &c." G. S. PAGE. Dated May 26. 2d. The inventor takes any or all of the following mineral substances, namely, metallic oxides, silicates, phosphates, aluminates, borates, carbonates, sulphur, selenium, or compounds of these; sulphides, &c.; compounds of tungsten and the like minerals; pseudo carbons and carbon in various forms in a state of fine division and suitably dried by heating, which he incorporates with the following organic substances either singly or in combination obtained from and by the preparation of certain portions of coal tar, coal tar oil, mineral oil or shale oil, naphtaline, anthracene, pyrene chrycine and their homologues and derivatives, from bitumen, natural asphalte, colophony, resins, natural gums, and resins, mineral wax and hydrocarbons, varieties of gutta-perchas and caoutchoucs, camphor in various forms or varieties; cellulose in various forms, as pyroxiline, &c.; also certain so-called waste organic substances, containing nitrogen in an albumenoid form of combination, tannin and other substances, containing tannic or tannogallic acid so called; leather and horn substances, &c.; the said organic substances being for this purpose obtained and employed in a liquid, semi-liquid, or gelatinous condition, as may be brought about by fusion or the employment of solvents, the said solvents being included in the list of organic and other substances claimed and detailed in this specification. (*Provisional only.*)

2567. "Heating by electricity." O. ROSE. Dated May 31. 6d. The objects of the invention are to obtain heat by the use of electricity, and to apply this heat to various purposes such as warming buildings, rooms, or carriages of all descriptions, cooking, evaporating fluids, obtaining steam, and every other object in which heat is necessary or useful. To carry out these objects the inventor takes a rod or small cylinder of iron or other suitable material of convenient length for the purpose, and covers it completely with asbestos or other non-conducting substance. Round this is coiled iron or other metallic wire in a spiral coil of suitable pitch, sufficient to prevent the contact of two adjacent parts of this wire. When this first coil has been made, four or more or less longitudinal strips of asbestos or other non-conducting substance are laid outside of it, and the wire is carried from the inner coil outside the strips and a second coil is laid in the same manner over these strips. The strips of asbestos or other substance are of such a size and thickness as to keep the one coil quite clear of, and free from, the other. In the same manner any number of other coils can be arranged, the one being outside the other, as may be expedient for the purpose. When a sufficient number of these coils are arranged, this apparatus is inserted in a tube, which may be closed at one end which tube is slightly larger in diameter than the outer coil of wire; and when it is placed in position in this tube and secured therein by a suitable method the tube is hermetically closed in any convenient manner so that the heat generated by the coils of wire inside may be retained. This tube so closed is inserted in another tube of a slightly larger diameter, and the annular space between the two tubes is filled with water. Electricity is then applied to the coils of wire inside, the ends of the wire having been left projecting out when the inner tube was hermetically closed.

2604. "Manufacture of incandescent electric lamps." F. DES VŒUX. (A communication from abroad by A. Bernstein.) Dated June 2. 6d. The object of the present invention is to produce an electric lamp which has the advantage of increased durability and illuminating power, owing to the fact that substances are employed which are capable of resisting the action of strong currents, so as to impart a high degree of efficacy and permanency to the lamp. The invention consists of an electric lamp, the light-giving part of which is made of any substance having the property of phosphorescence, and which is either entirely or partly covered with a deposit or film of carbon. The bulb or globe which encloses the light-giving part of the improved electric lamp has a stopper or closing part which is sealed into the neck of the bulb. The bulb is evacuated in the usual manner through a central tube or channel of the stopper. The platinum conducting wires are sealed into an annular collar of the stopper, which collar is arranged at some distance below the upper end of the central upward-extended portion of the stopper, so as to be little if at all affected by the heat emitted from the light-giving part. The conducting wires may also be sealed to the uppermost end of the central portion of the stopper if it be desired to increase the stability of the former. The wires are then spread apart so as to clamp the light-giving part by means of enlarged ends. The light-giving part is made of oval, cylindrical, spherical, oblong, or any other shape, and composed of any substance having the property of phosphorescence, such as calcined egg or oyster shells, chalk, lime, fluor-spar, the compounds of strontium, magnesium, calcium, &c. This light-giving part is partly or entirely covered with a film of carbon, which is deposited thereon by chemical or mechanical means, said film serving to conduct the current from one wire to the other, while the substratum of phosphorescent material serves as a support or carrier for the film of carbon and prevents the destruction of the same. The substratum or carrier has the properties of non-fusibility and non-conductivity and is heated up by the intense heat of the current, so as to form a luminous body, the light of which does not appear when entirely covered with carbon, while it is clearly discernible at that part which is not covered with carbon.

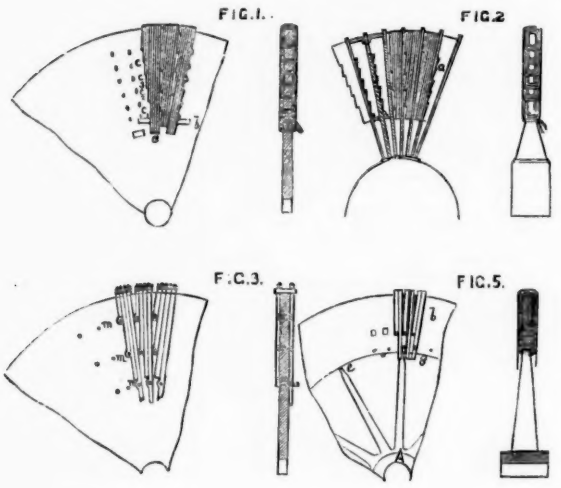
2613. "Electric lamps." W. E. AYRTON and J. PERRY. Dated June 3. 6d. The adjustment and feeding of the lamp is performed through the agency of an electro-magnet rigidly attached to the upper part of a frame, A B. The upper carbon-holder passes through the centre of the electro-magnet, which may be a magnet of one or more coils, but it is preferred to use one hollow cylindric coil with or without a hollow wrought-iron core. The inventors use a framework of any shape which enables the carbons to meet and to be in the same straight line. There is a tube partly of brass and partly of soft iron which is capable of sliding freely inside the electro-magnet or solenoid. It carries a frame, C C, at one end of which are hinges, D and F, for two levers, D E and F G. The levers are L shaped at the places H and

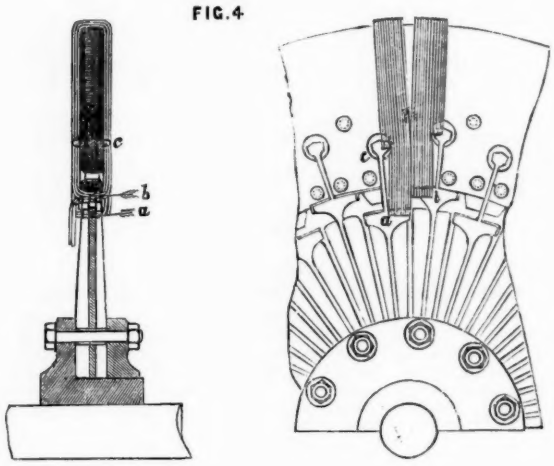


I and pass round the carbon-holder or the carbon itself, each pressing against the carbon-holder on the side remote from its hinge; the levers are slightly out of the horizontal, and it is found that although they are small, their weight is sufficient to prevent the carbon-holder from falling between them. It is easy to see that the carbon-holder can slide quite freely upwards, but is unable to move downwards unless the tube, frame, and levers move with it. The tube, frame, and levers carrying the carbon-holder or carbon are hung by spiral springs, J K, from the framing, and in the normal condition of the lamp when the electric arc has been formed, the downward suction of the tube together with the weights of the movable parts just balance the upward pulls of the springs. A small increase in the magnetism of the solenoid causes a downward motion of the tube and carbon-

holder. A small loss of magnetism causes an upward motion of the tube and carbon-holder. Now the electro-magnet is wound with a coil of considerable resistance which acts as a shunt to the electric arc. When the arc gets too long so that its resistance increases, more current passes through the magnet or solenoid and the carbon falls, shortening the arc. It cannot fall more than a very short distance, however, before the two little levers come in contact with stops at E and G, and this diminishes their grip and lets the carbon slide independently of the tube and frame, C. This is the feeding arrangement. Should the light from any cause go out, the magnetism of the solenoid gets very great, the carbon-holder falls rapidly until the carbons touch, a strong current passes through the carbons, very little electricity passes through the shunt circuit, the magnetism of the solenoid is weakened, and the springs lift the tube and frame, C, with the levers and carbon through a distance which is easily adjustable and which is the length of arc required. The frame, C, and levers may be on the upper side of the solenoid instead of the lower side as shown in the figures.

2618. "Dynamo-electric machines." R. E. B. CROMPTON. Dated June 3. The improvements in dynamo-electric machines relate more particularly to those in which the rotating armature is of disc or flat ring form, although some portions of the invention may be adapted to dynamo machines of another form. In the following description the word disc is used to mean any ring or disc the radial width of which is considerable in relation to its width measured parallel to the axis of revolution. The great difficulty hitherto met with by those using the disc form of armature is that the total number of coils that can be wound on to it is governed by the measurement of the inner edge of the winding, and as from this measurement has to be deducted the space taken up by the spokes or other attachments to the central hub by which the disc is sustained and driven if the radial width of the covered portion of the disc is at all great in proportion to the whole of the radius; the surface of the outer circumference covered by the winding will be relatively small in proportion to what is left uncovered. In the case of the radial width of the covered portion being one half of the total radius, not more than forty-five per cent. of the whole outer circumference will be covered with wire. By the improved method of winding which the inventor hereafter calls step winding, he avoids this waste of space. The step winding may be briefly described as follows: The inventor divides the disc off into as many segments as it is intended to have separate coils, and on each of these segments there are wound as many equal and parallel turns of wire as its inner circumferential width will admit of; the winding is then continued through a series of holes pierced through the disc, or steps cut in the segments in such manner and order that each successive turn of wire or groups of turns of wire, is rather shorter than the one preceding it. In this manner the otherwise unoccupied triangles are filled up with winding in a series of turns or groups of turns of wire, arranged stepwise, so that the whole of the wedge-shaped segments are completely covered. Figs. 1 to 5 show varied methods of the improved system of winding. Fig. 1 shows the side view and part cross section of a wrought-iron disc with holes, *a*, *b*, pierced through it in the manner shown in the drawing. The interior surface of these holes is lined with a suitable insulating material. There are other sets of holes, *c*, also lined or bushed with insulating material. The inventor commences to wind one of the segments shown at the oblong hole, *a*, and continues to wind the section as above described until the hole, *a*, is filled with wire. Afterwards he continues the winding through c^1 c^2 c^3 *et cætera*, until he has reached the hole most remote from the centre. This process has to be repeated for every individual section, until the entire surface of the disc is covered with wire, starting the winding at a hole *a* or *b* alternately. The ends of the wire of each section are dealt with in the usual way according to the system on which the machine is built, either by bringing the finishing end of the wire of one section together with the starting end of the next section to the commutator or otherwise as the case may be. It may be seen that the inventor does not confine himself to only one layer of wire, but he can, in the manner described, wind on layer after layer, until the required length of wire is wound on to the disc. In fig. 2 is shown another method of winding. In this case the disc core is built up of several segments made of malleable cast iron or other suitable magnetisable material, one edge of each segment being formed stepwise, as shown at *d*. These segments are arranged by preference in pairs, that is to say, two or more segments are so bolted or secured together or connected in such manner that they form a rigid and self-contained double or compound segment, capable of withstanding the tangential strain caused by the rotation of the disc. The advantage of this arrangement is, that the respective segments can be wound separately and built up into the disc, or be subsequently removed and replaced without disturbing the rest of the segments forming the disc. The winding is precisely similar to that shown in fig. 1, but it is evident that it can be effected much more easily and cheaply, as each segment can be wound before it is bolted to the next segment, and the winding can be effected in the lathe or by other suitable mechanical contrivance. Fig. 3 shows one of the methods of winding which may advantageously be adopted for dynamo machines of large dimensions where the armature coils are of such thickness that they virtually consist of copper bars; *m*, *m*, *m*, indicate the position of the steps of the winding. The drawing sufficiently shows the arrangement; each turn of the winding consisting of a stirrup formed of copper bar by preference of rectangular section, the connections between adjacent turns being made by copper bolts passing through the holes in the discs. In this the iron core may be either formed of several thicknesses of plate iron riveted together, or the centre may consist of a wheel-shaped body built up of phosphor bronze, manganese bronze, or any other non-magnetisable metal of sufficient strength and tenacity, having spokes and a rim connecting the spokes as shown in fig. 5. To the sides of this rim he riveted soft wrought-iron plates as shown at *b*, fig. 5, these plates to be of such radial dimensions as are required for the core. The space between these two side plates are filled by winding into it wrought-iron tape of a width corresponding to the distance between the plates, until the whole space is completely filled with wrought-iron tape and the core thus completed. In fig. 4 is shown another method of constructing the core so as to afford greater facilities for winding on the wire. The holes, *a* and *b*, corresponding to the oblong holes, *a* and *b*, in fig. 1,





are in this case connected by radial slots extending to the inner circumference of the plates. This enables the wire used for winding to be first coiled on a small bobbin, which can be passed through the hole in the centre of the disc, and so the wire can pass through the radial slots into the position it occupies in the finished winding. The construction of the core in fig. 4 may be similar to that above described for figs. 3 and 5, that is to say, the core may be constructed of a central casting of phosphor bronze or other suitable material, having the long oblong holes, *a* and *b*, formed in the casting, the side plates being subsequently riveted on at the rim, as in figs. 3 and 5, the space between the side plates being subsequently filled with wrought-iron tape, and the external holes, *c*, *c*, being subsequently drilled out and bushed with insulating material.

2619. "Electric lighting." R. E. B. CROMPTON. Dated June 3. 2d. In this invention the two carbons of the lamps are attached to sliding holders, so as to approach one another in the usual manner; the two are attached one to the other by means of cords, chains, or other flexible connections, passing over pulleys and so arranged that the travel of one carbon controls the travel of the other as the rate of wasting away of the point of the first is to that of the second. For instance, if, as is very generally the case, the positive carbon is made the upper one, and wastes away at twice the rate of the negative or lower one, the positive carbon would descend through two inches, whilst the negative one is ascending through one inch. The carbons for the purposes of forming the arc are separated, and in general the length of the arc is controlled by means of a solenoid or helix, suitably placed, the core of which is attached by a light rod or wire to the negative carbon, at or near the point on its incandescent cone where it wastes away under the action of the heat of the arc. This attachment may take the form of a ring pressing on the cone, or of a tube having one or more claws or pins projecting inwards so as to press on the cone, the core of the solenoid being attached as above to the ring or tube. (*Provisional only.*)

2628. "Collecting and transmitting electric fluid." H. DEFTY. Dated June 5. 2d. This invention relates to an apparatus of a combined arrangment to colect the Electric-Magnetic fluid produced form the natural chimical combinations of Metals and ores and transmit the same for use of illumination or work as motive power to Machinery This invention consists as follows—first there is an arrangement of Magnetised metals of straight or curved bars, built in a consecutive order, forming one combined Fagot or Pile to which is fitted at the rear a series of induction wires or rods, leading from a Bunker or store of Ferruginous Ores, to assist in sustaining the magnetic charge from the decomposing mines. Immediately over the positive ends of the Fagot or pile, there is attached a Steel cross bar, which the inventor names a "Shoe-accumulator, this being made in such form as to clamp or gather, and then conduct all fluid passing through the Fagot or pile into the core of the shoe accumulater where there is fixed in contact an arrangment of one or more circuit Discs, working on pivots, the above-named Discs being fitted with a number of copper wire coiles, which the inventor names the "Compounder, and so arranged as to swing or rotate in order to collect and reconcile within the circuit, the Magnetic waves or fluid to one central Electro-Motive force, discharging one continuous stream up the Disc points, where the current is received by union conducting Bars, and then transmitted through wires free from Variations or Broken undulations of current. The object to work Machinery or Burner for illumination of which the instrument consists, is a Small octagon, headed needle made of a reflecting substance to return the inside ray of Light which would otherwise be shaded and lost by the coil or plates as in ordinary use. For carbon Burners, the aforesaid carbon, Being finley powdred, and put into a Reservoior furnished with a small vent hole, in central position of the poles, which causes a continuous discharge, or supply of the carbon upon the Electric current producing a beautifull white or other colored light, acoording to the chimical Mixture with the carbon. The Motive Power required to carry out this process is by means of a fan wheel driven by the draft of a stack or chimney, or by a systom of water wheel, with an arrangment of conecting gear of Belts or shafting to the Electro Machine! ! ! ! (*Provisional only ! ! !*)

2636. "Dynamo-electric, magneto-electric, and electro-magnetic machines." A. L. FYFE and J. MAIN. Dated June 5. 8d. The object of this invention is to construct dynamo magneto-electric, electro-magnetic machines, and electro-motors as follows:—In all forms of existing machines there is a certain part of the armature during its rotation idle, which produces resistance without being active, and the object of this invention is to cut that part out of circuit. The armature is composed of any suitable number of segments of a ∪ form, and there is a core in this armature which may form part of it, and around which the insulated wire is coiled to suit the number of segments. This core may be hollow or it may remain solid. By this means the cores of the respective armature sections face the poles of the field magnets in a lateral direction thereto, and also to that of the axis. The field-magnets are so arranged that the intensity of the influence is equally distributed over the magnetic field of the poles. The disc or armature revolves between, say, two pairs of poles, which may be arranged at right angles to the axis or they may be arranged parallel thereto. Two or more of the sections of the armature may be coupled and each section or pair of sections may carry a brush, forming part of a spring or having a spring pressing thereon or any other suitable device, so as to cause the said brushes to bear against and revolve around a suitable commutator which is fixed. When the armature arrives at a certain position between the poles the brushes bear against a separate part of the commutator, and are thereby out of circuit during part of their travel from one pole to the other. The machine may be constructed so as to have any convenient number of discs, which may be joined up singly or in series. The machine may also be constructed to produce alternating currents.

2643. "Secondary batteries, &c." H. WOODWARD. Dated June 6. 2d. Secondary batteries or accumulators, as now constructed, are of a cumbrous nature, and so ill-adapted to hold any suitable quantity of electricity that their intent, and consequent utility, are nil. The object of the invention is, therefore, to remedy these evils, and to construct and arrange secondary batteries in such manner as to possess large storage capacity, and capable of being readily handled, and placed in any convenient position, owing to their compactness and form. Now, the invention relates, first, to the construction and arrangement of secondary batteries, or apparatus for effecting electrical storage, and for this purpose the inventor constructs the box, case, chamber, or shell of any suitable shape or form, but, by preference, in the form of a beehive, or of a dome, or of a bridge, or of an arch, and in order that it may offer or present a very large surface in a small space, he corrugates, flutes, folds, plaits, or undulates the sides, top, and bottom of such box, case, chamber, or shell, whereby he is enabled to reduce the size of the box, case, chamber, or shell to half (or more or less) its original size, according to the number of corrugations, flutings, folds, plaits, or undulations put into the same, while the box or chamber so constructed presents a very large surface in a very small compass. Within the box, case, chamber, or shell, so constructed, are placed the electrodes, which, according to the invention, are arranged or built up of plates, sheets or strips of lead, or other suitable metal, also corrugated, fluted, or undulated, and in arch, bridge, or dome shape, or other suitable shape, and one over and surrounding the other, such plates or strips following the inner line of the box, case, chamber, or shell, so that the corrugations, flutings, or undulations enter and lie within the corresponding corrugations or flutings of the plates or strips next and immediately below and above them; and in the case of the outermost plate or strip the corrugations or undulations enter and lie within the corrugations or flutings of the box, case, chamber, or shell, thus forming a compact nest of the said plates, sheets, or strips. (*Provisional only.*)

CITY NOTES, REPORTS, MEETINGS, &c.

The Telephone Company.

A MEETING of the shareholders of the above company was held on Friday, the 26th inst., in Cannon Street Hotel, to receive the report of the liquidator in regard to its recent winding-up. There was a very small attendance.

The liquidator, Mr. Charles Schiff, said: Gentlemen, it is my duty to-day to report to you the result of the liquidation of the Telephone Company, and I am happy to say that that liquidation has been carried out now completely, and with a very satisfactory result. In point of fact, every shareholder of the Telephone Company, Limited, received one share for each share that he held in the United Telephone Company, which as you know have been sold as high as £8, £9, or £10. They received further, in two distributions, each time, 10s., and I am able to distribute another 2s. 5d. as a final distribution. We have had £9,369 6s. 7d. of debts to pay, and the whole cost of the liquidation has amounted to £662 6s. 2d. On the other side we have cash for interest on deposit pending the liquidation the sum of £899 18s. 1d.; so that practically the cost of the liquidation has been less than the amount of interest that you have earned pending the distribution of the liquidation. I do not think that I have got anything more to add, and I shall therefore propose the necessary resolution, and after that is passed, the cheques for the 2s. 5d. of final distribution will be forwarded. I beg to move that this resolution be passed: "That the liquidator having laid before this meeting an account showing the manner in which the winding-up of the company has been conducted, and its property disposed of, resolves that the same is hereby approved and adopted."

Mr. H. T. Bird seconded the motion, which was carried unanimously.

The Chairman thanked those present for their attendance, and the proceedings terminated.

The Electro-Amalgamator Company (Limited).

ON Friday, 26th inst., the first general meeting of shareholders of the above-named company was held at the Terminus Hotel, London Bridge, Mr. W. J. Tanner, in the chair.

The secretary, Mr. Henry Beckwith, jun., having read the notice convening the meeting,

The Chairman apologised for the position he was occupying that day. It was only for that occasion, and he did so at the request of Mr. Gladstone, their chairman, who thought he, Mr. Tanner, might be able to explain any technical matters better than he could. This was merely a statutory meeting, held according to the statute; but he thought they could report satisfactory progress since the formation of the company on the 27th October last. When the company was formed we had a conference with Mr. Aston, Q.C., in order to settle the final specification, and as it was vacation time we were fortunate enough in having an unusually long consultation, and after going into the matter fully, Mr. Aston was perfectly satisfied as to the validity of the patent, subject to its not having been anticipated, a matter to which we have given our full attention by having the Patent Office thoroughly searched.

One of the chief charms about this patent is its simplicity, which consists of the application of well-known agencies for a particular purpose, and in a particular manner, which can be adopted at a remarkably small cost. From a scientific point of view the invention must carry out the objects for which it is intended, and from the scraps of knowledge I have been able to patch together, I think I shall be able to show you some strong evidence in support of the principle. I must remind you that I am neither an electrician, chemist, or mechanic, and, therefore, my remarks and opinions must be taken for what they are worth; but it seems to me there are so many diversities of opinion and so many theories about the properties and effect of electricity, that it is impossible to arrive at any conclusion that is altogether satisfactory.

As far as I understand the matter, it is simply this. Let it be given as an admitted fact that mercury, when fresh and clean, readily absorbs gold and silver when they come in contact with it. It must be also allowed that the presence of antimony, arsenic, mundic, titanic sand, and various other substances, sicken or coat over the mercury, and so prevent gold and silver from adhering to or amalgamating with it; and as there are vast quantities of ores with gold and silver all over the world that contain some one or more of these minerals, which are destructive to the mercury, it is obvious that any system that can be invented which will keep the mercury clean and bright, and always ready to take in the gold and silver, must be of immense value. That Barker's Electro-Amalgamator carries out this requirement is conclusively proved, both in theory and practice. Now, in the case of this invention the negative pole is applied to the mercury, and as mercury is a very good conductor of electricity, it, in fact, becomes our negative pole or cathode, the positive poles are strips or wires of copper or some good conductor, which are laid over but not touching the mercury. Just as the electric light is formed by making a break in the circuit and introducing carbon points, so our circuit is broken and joined, so to speak, by the agency of water, the water becomes chemically changed, and, of course, if chemical matters are introduced into this water, various other changes and modifications will take place. The first thing that strikes our notice on the application of the electricity is the immediate disappearance of any scum on the top of the mercury, it becomes as bright as it possibly can be. As the various substances that usually sicken it come under the influence of the electricity, they are immediately rejected, and the surface is kept constantly bright and in the fittest state for absorbing gold. This is conclusively proved by artificially sickening the mercury; directly the electricity is applied the matter that sickened

the mercury is ejected, and the tiny globules into which it has been beaten run together, presenting a bright and uniform surface.

Now, gentlemen, I think it logically follows if the electricity will purify the mercury when sick, it will *a fortiori* prevent it getting sick when pure. The invention in this respect is of enormous value, but I contend that the keeping the mercury clean is not the only point gained, and I think it will be admitted that the electricity induces the contact between the gold and silver and the mercury; in this way certain minerals are driven by diamagnetic action from the positive to the negative pole, and among them gold and silver; now, as the crushed ore passes over the mercury it is conveyed by means of the water between the negative and positive poles, and each gold particle becomes an electrode, with the obvious effect that it is impelled from the positive to the negative pole; in our case the negative pole is clean mercury, which readily absorbs the gold and silver particles, so we have not only the natural gravitation of the gold but the diamagnetic force, which, I think, possibly precipitates the gold in the mercury, leaving it clean at the top. Why, it may be asked, are not other metals, like iron and copper, equally by the same influence driven to the mercury? so, I say, they are, but as the mercury has no affinity for these metals they are kept moving over the mercury, getting as far as possible from their enemy the positive pole until they are thankfully washed away by the water. In the case of sulphurets the action is different, they become decomposed and thus liberate the gold, and, instead of depositing themselves on the negative pole and sickening it, they judiciously avoid it and go to the positive pole, attracted by the copper, and get formed into sulphate of copper.

It is more than satisfactory to find these theories are practically proved true, for if you refer to pages 10 and 11 on the pamphlet which has just been issued, you will see that out of some sand given to us from one of the Indian mines, assaying 2 ozs. 13 dwts. to the ton, by the electro-amalgamator process we have taken 2 ozs. 11 dwts. Now the analysis of this sand shows nearly 61 per cent. of titanic acid and iron, so there can be no wonder that with the ordinary process the gold could not be extracted. I understand there are thousands of tons of this sand, and the results we have shown with our treatment is worth £50,000 a year to the owners of this property. This is not an isolated instance, but from the information I can gather it forms an example of the rule, and by no means an exception; indeed, I can assure you, gentlemen, I am bewildered at the possible value to the world at large of this invention. From all quarters I hear of the thousands of tons of gold and silver ores that are unworkable from the presence of the obstacles that this invention removes. There are generally two values to saleable property, first, its intrinsic value, and secondly, what you can get for it. Now, this invention being all that is claimed for it, its intrinsic value is many millions, this we cannot expect to get, except, perhaps, indirectly. A person came to me some months ago with the view of purchasing one of the patents. I told him we were not ready, and before the invention was made public we wished to prove it and perfect it on a commercial scale. He said, "You take my advice, if it is really good and will bear looking into don't be in a hurry to part with it; if it is worth nothing, sell it at once." Now there is a sublime simplicity about this system of financing that I fear is more remarkable for its success than its morality.

We, as directors of this company, have not only your interests to protect, but our names, and therefore we must take personal care that any patent we offer for sale will bear looking into, as there is no consideration sufficiently large to induce us to foist anything upon the public unless we are clearly satisfied it is all we claim for it. I do not see that we attack any vested interests, on the contrary, the vast amount of capital invested in gold and silver mines that do not pay will now return profits, and those mines that do pay will pay more. All we require now is gradual publicity. In this, I am sure, you will help us. I say gradual, as, owing to the small space at the works, there is not room to have a large assemblage at a time, but both scientific and practical men who have seen the invention have always expressed themselves as strongly impressed with its value, but we must make it generally appreciated before we can expect to sell any of the patents at anything like their actual worth.

I am very much obliged for the kind way in which you have listened to my remarks, and I shall be happy to answer any questions to the best of my ability, but I am not prepared to join issue where any scientific principles are involved.

Mr. A. Howlatt: Did I understand that you have negotiations on foot at the present time for the sale of any of the patents?

The Chairman replied that they had no negotiations at the present moment for the sale of their patents, the reason being that they had not till within the last few days made the matter public at all. Moreover they were not yet possessed of all their patents.

Mr. Howlatt remarked that he thought some reference was made to an Indian patent, as though there were some offer.

The Chairman said the directors had been in communication with some of the Indian mines, not directly, thus early, with a view of selling the patent, but with a view of getting them to consider the advisability of using such a machine for washing their quartz.

Capt. Howlatt asked if the board would make any statement as to the mode in which the funds already subscribed had been applied.

The Chairman replied that it was not usual to lay anything of the nature of a balance-sheet before the statutory meeting.

Capt. Howlatt said he did not need the exact figures, but only a rough statement of how the money subscribed had been spent.

The Chairman replied that the board had a few hundred pounds in hand. The patentee had received £1,000; and £800 or £900 had been expended in rent of premises and machinery generally.

A Shareholder: I suppose you have no other heavy expenses? will there be any further call?

The Chairman: In all probability the whole of the capital will be called up. It is a question. I am not sure of that in my own mind. There is a difference of opinion amongst the board as to whether it will be necessary to call up the remainder of the capital if we sell patents.

In answer to a question from Capt. Howlatt, as to the division of profits,

The Chairman said that those who had paid only six-tenths would not receive the same as those who had fully paid up, and he instanced in illustration of what he meant the division made by the Anglo-American Brush Corporation, who divided 100 per cent. upon the money paid up.

Mr. Gladstone (Chairman of the company): I think we shall require the whole of the shares.

Mr. Howlatt said he thought every shareholder had a right to share rateably.

The Chairman: Well, we shall make that point well known and satisfactory to you all before the matter is decided. My own opinion is that you should divide the profits upon the amount paid.

A Shareholder: I beg to differ—per share.

Another Shareholder: We have not caught our hare yet (laughter).

A Shareholder: What will the money be required for?

Mr. Gladstone (Chairman of the company): For the purchase of patents. We have several not back yet.

The Chairman: We have none of the South Australian patents back yet, and cannot have until February.

Mr. C. Randolph: Suppose you sell the Indian patents between now and February? If so, you would not want to call up the rest of the money?

The Chairman said they had bought of Mr. Barker all the patents, with the exception of the American, which was left in abeyance for the present. They paid for their half of the patent £4,000 in shares and £1,200 in cash. When the American patent was received they paid a further sum of £3,000 in shares and £1,800 in cash. That would make £10,000 he would have received when they got the American patent—£7,000 in shares, fully paid up, and £3,000 in cash. The cost of the patent was deducted out of the patentee's fee.

A Shareholder: How many patents have you received?

The Chairman said the protection of the English patent was taken out in June last, but they did not get it back again until October.

Mr. Gladstone said although they had not yet got all the patents, they might have them very shortly—to-morrow it might be. They knew, however, that they were all right, that there was nothing in the way.

After a pause, Captain Howlatt said he thought one thing had been forgotten by the directors, and that was a statement of the work they had done. He thought the shareholders should consider what compensation they should make the board for the anxiety involved in conducting the company. Perhaps the board would give the meeting some idea of what they had done, so that they might form some opinion as to what would be adequate remuneration.

The Chairman said, under Table A of the articles of association, the remuneration of directors was to be fixed by the shareholders in general meeting, but he might say that the board did not intend to take any part of the subscribed capital as remuneration. They would take it out of the divided profits, and whatever proportion of these the shareholders might see fit should be divided amongst them. Of course the greater the profits the greater the labour that might be entailed.

Mr. C. Randolph: If it is a blank you get nothing?

The Chairman: Yes, sir.

Mr. H. B. Hewitt: I will propose that the remuneration of the directors for the ensuing year be 5 per cent. on the profits actually divided during that period.

Mr. C. Randolph: I think that will meet with our approval. We have seen to-day how much labour and trouble they have taken in this matter, and probably there will yet be much more to do. I think it is the smallest sum we could vote to the directors out of the profits.

Capt. Howlatt suggested a graduated scale of payments according to results, in case the earnings should not be up to the figures anticipated by the directors. If the earnings were very small, five per cent. might be too much to pay. He did not offer that as an amendment; he thought it a point worth considering.

Mr. Hannam was of opinion that the five per cent. was the least they could offer. Their directors, he thought, were more responsible than the directors of an ordinary company. The anxiety in connection with this matter must be very great, for it was impossible to tell what was the value of the invention. If the board earned for them £1,000,000, he should not grudge them the £50,000 for remuneration.

The proposition for a five per cent. payment was then put and carried.

In answer to a further question as to how many patents the company had already got, the chairman said they had those for France, India, Canada, Portugal; Germany was "going thro'"; Spain was not granted yet; South Australia they could not possibly get yet; and for those for Chili, Peru, and the Brazils they had special agents resident there taking out the patents for them. They thought it the best way to put it in the hands of gentlemen in those countries, who they had no doubt would get some Bill passed or other adequate measures for fully protecting the company's rights.

The proceedings shortly afterwards concluded with the vote of thanks to the chairman.

NOTE.—Since the meeting the directors have received the results of some washing of ore from perhaps the richest gold mine in the world, the quartz from which shows by assay 44 ozs. gold to the ton, but owing to the refractory nature of the ore, sufficient gold in paying quantities has not yet been obtained. Mr. Fred. Claudet's assay shows that Barker's process has extracted 38 ozs. gold out of the 44, or about £130 per ton.

H. BECKWITH, Jun., *Secretary.*

The Anglo-American Brush Electric Light Corporation (Limited).

[The following circular has been issued to the shareholders of the above-named company.—EDS. ELEC. REV.]

Belvedere Road, *24th January*, 1883.

Gentlemen,—You will, no doubt (if you were not present) have seen from the newspaper reports of a meeting held yesterday, at the Cannon Street Hotel, of the members of this corporation. At that meeting the usual resolution was moved for approving and adopting the report and balance-sheet presented by the directors; and an amendment was moved thereto and seconded, in the following words: "That a committee of shareholders be appointed to consider and report upon the affairs, position, and general conduct of the corporation." A prolonged discussion on the question of this amendment followed, and in the course of that discussion a number of speeches were made, some of them by parties having interests antagonistic to those of the corporation, assailing the policy of the directors and their management of the corporation. On the amendment being put to the meeting it was declared to be carried, and a poll was demanded. The poll will be taken on Tuesday, the 30th inst., at the Cannon Street Hotel, E.C., between the hours of 2 and 5 p.m.; and as further proxies will not be available, you are urgently requested, if you did not send in your proxy prior to the meeting held on the 23rd instant, to attend and vote in person.

The point at issue, on which the votes will be taken, is of an important character. The directors, personally, would court all possible investigation; but they are of opinion that any report, as proposed, of a committee having power of inquiry without limit into every detail, including the trading operations of the company, might be attended with great injury to the company. In making such a report the committee would have to deal with a great variety of matters which could only properly be treated with an intimate knowledge of past transactions. Having regard to the rival interests involved, the numerous companies with which the corporation has to transact business, the complicated questions which are pending, or may at any time arise between the corporation and others, including their rivals in electric lighting, the delicacy and difficulty of the task cast upon such a committee would be obvious. And if any member of such a committe should happen—as was the case with many who attended and voted at the recent meeting—to be directly or indirectly interested in companies owning concessions and dealing with the corporation, or in rival companies having interests antagonistic to the corporation, the injury that might result to the permanent interests of the corporation would, in the opinion of the directors, be vital and possibly irreparable.

The directors, therefore, consider that they would be unworthy to occupy the positions they now hold if they were to consent to the course which is thus proposed; and they have unanimously decided that if, on the poll being taken, the amendment be carried against them, they will retire from the board and will be prepared at the earliest moment to hand over their functions to any other gentlemen who may be appointed.

The directors are willing to encounter any possible difficulties which can arise, and to labour, as they have always hitherto done, for the best interests of the shareholders, so long as they enjoy their confidence, and desire to shirk no responsibility; but they cannot accept a proposition which they feel to be not merely unnecessary, but in the highest degree prejudicial to the best interests of the corporation; and they have, therefore, thought it their manifest duty thus to place the position plainly before the shareholders, in order that no mistake may arise in regard to the question which is now at issue.

It may be as well to state, in reference to allegations freely made at he meeting, and to which there was no sufficient opportunity of replying, that the directors have, during the past six months, been earnestly engaged in, and have now perfected, the manufacture of a new class of economical machines for incandescent lighting, and of apparatus of various descriptions essential to the success of domestic and general electric lighting. The factories are in the best possible condition, and their facilities unequalled for extensive work, and the directors lament the dissensions which threaten to paralyse their long-continued efforts. The success of the company's operations may now be seriously jeopardised at a time when the Electric Lighting Bill may shortly be expected at length to produce the effect for which it was promoted. Provisional orders being obtained, the proprietors may reasonably anticipate a great impetus to the business, and a satisfactory result from the past labours of the board, which have been of no ordinary character.

There is already one vacancy at the board, which the directors had hoped to fill up with the name of some influential shareholder who might have been found for the vacancy; and the directors would have pleasure in receiving amongst them other shareholders interested in the property of the company, if suitable names are suggested to them. This course had already been proposed by them, and if it is not adopted, and the amendment is carried against them, they can only consider it as a vote of want of confidence, and they will be prepared, as already stated, to retire accordingly.

The adjourned meeting to be held on Tuesday, the 30th instant, for the purpose of taking the poll, will be further adjourned until Monday, the 5th February, at the Cannon Street Hotel, at twelve o'clock, for continuing and completing the business for which the general meeting was convened.

By order of the Board,

WILLIAM J. CORDNER, Secretary.

The Cuba Submarine Telegraph Company.

On Wednesday, the 23rd ordinary general meeting of the shareholders of the above-named company was held at the company's offices, 61, Old Broad Street, Mr. Joaquin de Mancha, chairman *pro tem.* of the company, presiding.

The secretary, Mr. James Scott, having read the notice convening the meeting, and the report and accounts having been taken as read,

The Chairman said: Well, gentlemen, the accounts having been before you now for several days, and as we rather pride ourselves that our accounts are always so clear, I suppose they do not require much commendation from the chair. You will also see therefrom that our late respected chairman, Mr. Thomas Hughes, has resigned his position on the board. We all regret his absence. The ability and experience which he had will rather cast me in the shade, but I can only say I will do my best to conduct the business of the company in the same way that it has been hitherto (hear, hear); and if there is any shortcoming, I must trust to your generosity to overlook anything that is not quite the thing. The accounts show that after providing for the preference dividend of 10 per cent., we shall be able to recommend that a dividend of 7 per cent. on the ordinary shares be paid you. I think, taking the thing altogether, you will consider that very satisfactory (hear, hear). We shall divide for the half-year 7½ per cent., and looking at the accounts, you will see that besides that, we are able to place to the reserve fund £1,325. Some gentlemen may, perhaps, think that the reserve fund is getting too high. For my part, I should like to see it very much higher. The business of a telegraph company is so very uncertain, subject to so many casualties and unforeseen events, that I think the stronger the reserve fund the more satisfactory it will be to you, gentlemen, to be able to reckon that the dividend upon the ordinary shares will not be diminished so long as we have sufficient funds for any repairs that may have to be undertaken. The business of the company, I am glad to say, has during the year been very prosperous. We have earned £5,000 more than in the previous year; and I think, taking into consideration the little business that has been general all over the world, we cannot complain. We have a very substantial increase on the previous year's income. I am sorry to say the cash does not come in so much in proportion to the increase of telegrams. We have had nearly 5,000 more messages. We generally reckon that every telegram produces nearly £1; but we are finding that the people are being more expeditious in telegraphing and curtailing their messages; so that we have not increased so much in point of money as in point of messages. But we cannot complain of the success of the company. With these few words I shall now propose that the report and accounts be received and adopted; and if any gentleman has any question to ask I shall be glad to answer him.

Mr. A. F. Low (one of the board) seconded the proposition.

There being no questions asked, the chairman then put the proposition, which was carried *nem. con.*

The Chairman: I have now pleasure in proposing that a dividend of 7 per cent. free of income-tax on the ordinary shares be paid—and these certificates will be posted to you to-night—and of 10 per cent., subject to income-tax, on the preference shares be paid also.

Mr. Low seconded, and it was carried.

The Chairman: That is all the business before you here to-day, gentlemen.

Mr. W. Griffiths said he thought that they ought not to separate on that occasion without placing on record their appreciation of the services rendered by Mr. Thomas Hughes to that company. While they were glad to hear of his promotion, they were bound to regret the loss the company sustained by his removal. He was connected with the company from its commencement. He was a man of clear and acute judgment, of considerable intelligence, of comprehensive understanding, and had always shown the most gentlemanly bearing. He had presided over the company in prosperity and adversity, and he thought they might say without dispute that they were fortunate in having such a gentleman at their head, one who had received a legal training and who was able to bring those and many other qualities to the services of the company. Their company had extensive foreign transactions, and the knowledge of foreign international law which he possessed must have considerably facilitated the transactions of this business with the Spanish Government and in the Island of Cuba. They had seen the way in which Mr. Hughes had conducted the business of the company, and any information he could give was always readily and kindly given. When he said he regretted the departure of Mr. Hughes, he did not intend, of course, to cast any reflection upon the other directors of the company. He hoped they would all agree with him that it was a proper thing that they should express their sense of the benefit which the company had received from his presidency, and that it was also right that they should express their hope that those great qualities which had been of so much service to them would hereafter be of service to others in a wider sphere, that he will not only have the satisfaction of remembering that he had been a successful chairman of a telegraph company, but as one of the members of the judicature of this great country. He would propose that the directors be instructed to express to Mr. Thomas Hughes, Q.C., their sense of the value of his past services, and their hope that similar success would attend him in the new sphere of labour to which he was called (hear, hear).

Mr. Newton seconded the proposal, remarking that he thought the services rendered by Mr. Hughes to the company were very important. They had had satisfactory dividends, and the position of the company was now very favourable as regards the shareholders themselves.

Mr. Thomas Greenwood, auditor of the company, approved of Mr. Griffiths' proposal, and added that he should like, if it met with the

approval of the shareholders generally, that there should be some gratuity given to Mr. Hughes. Something tangible should be added to that resolution in the shape of a few guineas. He had been with them for a long time, and the business had been conducted in a satisfactory way. He thought they should not part from him without expressing the feeling that they entertained towards him, and offering him something substantial. He appreciated the course the board had taken in not immediately filling up the vacancy. He hoped they would keep it open till they found some gentleman experienced in City business and with commercial knowledge; and he hoped also that they would never fill it up with any person who held a prominent position on any other telegraph company. Other companies had, in his judgment, suffered from such an arrangement. He liked to be friendly, of course, with his neighbours, but he did not like to have his neighbour in his house unless he wanted him (hear, hear).

Mr. W. Griffiths said that he hardly felt competent to propose that the funds of the company should be devoted to the purpose which had been suggested. Although he would not oppose such a thing he thought rather that those who were of opinion that such a testimonial should be given to Mr. Hughes should initiate the matter themselves. Of course he thought it wise to be friendly with other companies and lay themselves open for business from them. No doubt the largest proportion of the business of the company went through the United States to Cuba; therefore they should be friendly with the Anglo-American and other such large companies. Referring again to Mr. Hughes, he doubted whether that gentleman would care for a purse of money, or whether he would express his approval of receiving fifty or a hundred guineas.

The Chairman: Hardly likely, I should think. For my own part I should feel rather hurt if I were offered that sum. Mr. Hughes is not in a position to require a hundred guineas. I should not be one to present a testimonial to him in the shape of a sum of money. If a sum of money were voted I should not put it from the chair. I should think I should insult him.

Mr. Newton said they might ask permission to contribute fifty guineas to the fund which is being raised by the North of England Co-operative Societies.

Mr. Griffiths said he would suggest a piece of plate with a complimentary inscription.

Mr. Keenlyside said he approved of the suggestion of Mr. Greenwood that something more tangible than a mere written expression of regard for his past services should be given. He thought they should give him a piece of plate. He did not see how the co-operative societies in the North were in any way related to this company.

A Shareholder (who refused his name) said they were very much dependent upon what they got from the companies, and he did not think they ought to bind the shareholders as a body. Let those who were for giving a testimonial to Mr. Hughes do it themselves. He had every respect for Mr. Hughes, but he did not see that they were bound to make a call upon the shareholders or give the proposed piece of plate. It was quite an unusual thing.

Mr. J. A. Brown said it appeared to him that if the present were to be only 100 guineas it would be more convenient that it should take the shape of a piece of plate.

Mr. Greenwood said as the wish of the meeting was against the money testimonial, he would be pleased to adopt the suggestion of a piece of plate. He had not made the suggestion without precedent. He did not think it would be *infra dig* on the part of Mr. Hughes. If it was to be done in the shape of plate he thought 50 guineas a suitable sum, and he should like to add that to Mr. Griffiths' motion.

Mr. Griffiths said he would take the amendment, but he did not know how far they ought to bind outside shareholders.

The Chairman, while in the act of putting the proposition, remarked that the sum of fifty guineas seemed rather small; he would rather make it 100 guineas, if they did it at all. If the meeting would allow it, he would suggest that they give Mr. Hughes a piece of plate value 100 guineas (hear, hear). He thought the company would not feel the outlay, and it would be an appropriate mode of expressing their thanks.

Mr. Griffiths: Let 100 guineas stand as part of the original proposition.

The motion was then put and carried.

Mr. Newton asked what the chairman's views were with respect to the election of a chairman in the place of Mr. Hughes.

The Chairman: You have heard what we have said. We do not at present intend to fill it up.

Mr. Newton said he thought that the board should appoint a gentleman who was in no way connected with the telegraph companies. He hoped they would select one whose name was not associated with a dozen other companies. He felt sure the business of this company could not be properly attended to if that were the case.

Mr. Brown was of opinion that the appointment of a gentleman connected with other companies would be a sort of two-edged sword. It might cut good to them if it did harm.

Mr. Griffiths, referring to the question of the election of a chairman said they had now the smallest number on the board that they could have by the articles of association, and if the same incident occurred as in the case of the death of their late auditor, they might find themselves in an awkward position. He referred to Article 67.

The Chairman said if that contingency were likely to occur with any of the directors the board would probably have filled up the vacancy already.

Mr. Griffiths: But there would be only three to do it.

The subject then dropped, and a vote of thanks to the chairman, proposed by Mr. Keenlyside, concluded the proceedings.

The Anglo-American Telegraph Co. (Limited).—

At a meeting of the board of directors of this company, held last week, it was resolved (after placing £37,500 to the credit of the renewal fund for the quarter ending 31st December, 1882) to recommend to the proprietors at the next general meeting of the company, to be held on the 9th February next, the declaration of the following dividends, all free of income-tax:—(1) a balance dividend of one per cent. upon the ordinary consolidated stock for the year ending the 31st December, 1882; (2) a balance dividend of two per cent. upon the preferred stock for the year ending 31st December, 1882, both payable on 10th February next. After paying the foregoing dividends there will be a balance of about £6,900 to be carried forward to the next account. The above dividends, together with those already paid, will amount to 2¾ per cent. on the ordinary consolidated stock, and 5½ per cent. on the preferred stock for the year 1882.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations. Jan. 31.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	5	5⅞ - 6⅛	6 7/16.
		Do. Do.	19	10½ - 11½	
30,000	5	Australasian Electric Light, Power & Storage Co.	3	½ - 1	¾
24,900	10	British Insulite Co., Limited, "A." Shares	5	2 - 3	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	½ - ¾	
25,000	5	Great Western Electric Light & Power Co.	2½	..	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	3½ - 4	
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	½ - 1	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½ - 2	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	½ - 1	
..	..	South African Brush Electric Light & Power Co.	2½	¾ - 1½	
100,000	5	Swan United Electric Light Co., Limited	2½	2½ - 2¾	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	50 - 51	
2,441,800*l.*	Stk.	Do. Preferred / Def'd. receiving no div. until	100	81¼-82½	82½
2,441,800*l.*	Stk.	Do. Deferred / 6 p. c. has been paid to Pref.	100	18 - 19	18½
130,000	10	Brazilian Submarine, Limited	10	12 - 12½	12½
16,000	10	Cuba, Limited	10	10 - 10½	
6,000	10	Do. 10 per cent. Preference	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	6¼ - 6¾	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	16¾
65,000	20	Direct United States Cable, Limited, 1877	20	11¾ - 12	11 15/16-11 15/16-12xd
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10⅝-11¼	11 1/16
70,000	10	Do. 6 per cent. Preference	10	13¼ - 13¾	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	103 -106	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	105 -108	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11¼ - 11½	11 5/16-11 7/16-11 7/16 xd
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	109 -112	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	103 -106	
140,000	100	Do. do. registered, repayable 1900	100	103 -106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	103 -106	
254,300*l.*	100	Eastern and South African Limited 5 per cent. / Mort. Deb. Registered redeemable 1 Jan. 1900	100	103 -106	
345,700*l.*	100	Do. do. To Bearer	100	103 -106	
22,050	10	German Union Telegraph and Trust, Limited	10	10 - 10½	xd.
163,390	10	Globe Telegraph and Trust, Limited	10	6¾ - 6¾	6 7/16
163,209	10	Do. 6 per cent. Preference	10	12⅜ - 12½	12 3/16-12 5/16
125,000	10	Great Northern	10	12 - 12½	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	31½ - 32½	32 1/4-1/4-3/4-2
100,000	100	Do. 6 per cent. Debentures, 1888	100	101 -104	
17,000	25	Indo-European, Limited	25	32 - 33	
38,148	10	London Platino-Brazilian, Limited	10	4⅛ - 4¾	
12,060	10	Mediterranean Extension, Limited	10	1¾ - 2	
8,200	10	Do. 8 per cent. Preference	10	6 - 8	
9,000	8	Reuter's, Limited	8	10½ - 11	
280,000	Stk.	Submarine	100	252 -257	
58,225	1	Do. Scrip	1	2¼ - 2⅜	
4,200	Cert.	Submarine Cables Trust	100	105 -109	
37,350	12	Telegraph Construction and Maintenance	12	33½ - 34½	34 1/4-1/4-3/4
150,000	100	Do. 6 per cent. Bonds, 1894	100	100 -103	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛ - 1⅜	
30,000	10	West Coast of America, Limited	10	4½ - 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7⅛ - 8	7 13/16
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	98 -101	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	122 -126	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1¼ - 1½	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	
4,669	10	Do. 6 do. 2nd do.	10	5 - 5½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	⅜ - ½	
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	¼	⅜ - ½	⅜
100,000	5	United Telephone Co.	5	10¼-10½	10 1/4-1/4-3/4-1 5/16-3/4

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company. The traffic receipts for the week ending January 5th, 1883, were £3,356, and for the week ending January 19th, 1883, were £4,385.

The Western and Brazilian Telegraph Company (Limited). The traffic receipts for the week ending January 12th, 1883, were £2,305; for the week ending the 19th, £2,952; and for the week ending the 26th, £2,723, each after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

The West India and Panama Telegraph Company. The estimated traffic receipts for the half-month ended January 15th, 1883, were £2,118, as compared with £2,188 in the corresponding period of 1882.

The Eastern Extension (Australasia, &c.) Telegraph Company (Limited). The traffic receipts for the month of December, 1882, were £31,617, as compared with £31,319 in the corresponding month of 1881.

The Great Northern of Copenhagen Telegraph Company. The traffic receipts of December, 1882, amounted to £17,640.